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EDITORIAL

THE new graving-dock at the Bremerton Navy Yard has been completed. The dock is 130 by 950 feet and has a hull-accommodation depth of 30 feet.

GASOLINE-GENERATED power was used extensively in many parts of the East and Middle West during the recent coal shortage. Many plants, particularly automobile factories, by connecting all available motors to the shafting, were able to continue production, whereas otherwise it would have been impossible.

THE attention of our readers is especially called to our leading article on 'Quantity Production Methods for Increasing Foundry Production', by W. S. Falstbeau. Mr. Falstbeau is in charge of the patternmaking department of the Holt Manufacturing Co. at Stockton, coming there a few years ago from the Buick company, and is qualified by long experience to speak with authority on this subject. We particularly commend for meditation his statement that if we cannot compete with Eastern manufacturers, using the same methods, it is up to us to improve on their methods.

BRITISH LABOR appears in some ways to have a more radical attitude than Labor in this country, but reports indicate that the 'vicious circle' of higher wages and higher prices is receiving a good deal of thoughtful consideration from labor leaders on the other side of the Atlantic. They very properly ask consideration for such measures as release of Government foodstuffs, the removal of control in order to stimulate competition, prevention of speculative and overcapitalizing operations of great industrial syndicates, and stringent anti-profiteering action. On the other hand, some labor leaders, at least, are advocating universal payment by results, with binding guaranties against the reduction of piece-rates, and also increased production under conditions whereby the workers will be safeguarded from any attempt at exploitation and given an adequate share in the results of extra production. These latter measures are 'radical' in a certain sense but not in the present common usage of the word.

SCARCITY of paper is a problem that has faced the publisher for several years, and has recently become acute. Many dailies have been obliged to reduce the number of pages in their editions, and, at this writing, there is some discussion of making this reduction obligatory. Whether or not a decrease in the size of some of the Sunday papers would be an unmixed evil is a question that we leave to our readers to determine. Fortunately, as far as METAL TRADES is concerned there is no likelihood of our having to reduce the number of pages. It has, however, become advisable, commencing with this issue, to change from a 'coated' to a 'plain' paper for the body of the magazine, retaining the coated stock for the cover. As our readers can easily determine for themselves, this makes no difference at all as far as the text is concerned, and the difference in the appearance of the illustrations is negligible. The subscriber will still be paying for his magazine rather less than the cost of paper and presswork.

ALARMISTS and other busybodies have frequently tried to get us all wrought up over the supposed fact that the French were not going back to work, and that we in the United States would be compelled to keep on supporting them indefinitely. The Department of Commerce has recently published statistics regarding conditions on September 1 in the liberated regions of northern France, where the difficulties in the way of returning to normal are admittedly the greatest. These show that of 1986 firms employing more than 20 workers before the War, 1027 firms had resumed activities, and that this resumption was proceeding at the rate of more than 150 firms per month. These 1986 firms employed 497,326 workers in 1914. On September 1 last, the number employed was 82,907, to which should be added 73,931 employed in clearing the ground in re-building industrial plants, also 13,200 prisoners of war still employed in the liberated regions. When all the circumstances are considered, we believe that this record, in less than a year since the armistice, will compare favorably with the reconstruction record after other great disasters, whether natural or the result of war.

THE typical 'good citizen' is the man who growls all the year round about the way the Government is being run, but is too engrossed in his own selfish interests to take any part in politics, and frequently is so lazy as to neglect to vote. One would think, after the general strike in Winnipeg last winter had failed largely because certain patriotic city officials refused to be bluffed, that the voters of that city would be alive to the importance of taking part in public affairs. On the contrary, at a recent election, the vote cast was only 50% of the registration. As a result, the city council of 14 members is evenly divided between men with pronounced radical sympathies and patriotic citizens opposed to class rule. The mayor fortunately belongs to the latter group, but this leaves control of the city government too evenly divided for comfort. Even worse is the case of Milwaukee, where Victor Berger, a convicted criminal once refused admission to Congress, has been chosen a second

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time in his district by 24,000 to 19,000, but with 9000 voters staying away from the polls. What makes these occurrences particularly serious is that they are typical of conditions in so many communities. Both the man with some special interest and the man with some sort of bee in his bonnet are sure to go to the polls, while the 'good citizen' too frequently turns out to be good for nothing, not even to vote.

The Same Old Bunk

We are in receipt of a bulky mass of propaganda, which we assume is being sent generally to periodicals of all kinds, from the so-called 'Friends of Irish Freedom'. We also assume that they wish us to comment upon it, which we will do. We know a great many Englishmen and a great many Irishmen. Individually, most of them are fine men. We are truly sorry that, collectively, the English and the Irish are not getting along well together in their own country. If certain Irishmen wish to plot against the British government, that is their privilege. If the British government chooses to defend itself against these Irishmen, that is its privilege. The only interest that we as Americans should feel in the discussion of 'self-determination for Ireland', without, mind you, self-determination for Ulster, other than as friendly a feeling as possible for all parties concerned, is that the entire dispute should be kept where it belongs, and not carried to the United States, as the 'Friends of Irish Freedom' are trying to do. Such an attempt is as much out of place as an attempt by British subjects to interfere in our negro question or Indian question would be. There is, however, another aspect of the case that deserves mention. We have indisputable proof that during the War the leaders of the Sinn Fein movement did all they could to help the Germans, and that some of them, at least, connived at attempts to murder our soldiers and sailors on the high seas. Their utterances therefore should have the same consideration, and no more, as that given to the statements of other convicted but, unfortunately, unpunished criminals.

Coal Strike Ended

After about a month characterized by technical observance and actual defiance of the injunction, peace has been obtained in the coal districts through a compromise by which the strikers get a 14% increase at once with a chance of more after 60 days, provided the arbitrators see fit to grant the same to them. In a sense, the miners have gained by striking, since, of the two principal offers of settlement made before the strike, one provided for arbitration without any immediate increase of wages, and the other for a 20% increase without further arbitration. However, when we consider how long a time the miners will have to work in order to 'break even' for their period of idleness and also the loss in prestige they have suffered because of their defiance of the public, it would appear that the miners, as well as everyone else concerned, had lost because of the strike. Nevertheless, we believe that in the long run all concerned, including the long-suffering public, will benefit as a result of the strike for the reason that it has brought to the people's attention, as nothing else could, the unscientific and inhuman way in which the coal industry has been operated. It is unfortunate but none the less true that the only way to gain the average man's attention is to hit him with a club. The coal strike served admirably as a club. Whether or not any immediate change will come, it is only a question of time until measures will be taken that will permit coal mining to become an all-the-year industry instead of a seasonal one.

Justice Moves Slowly

Twenty-seven years ago Alexander Berkman forced his way into the offices of Henry C. Frick, shot him twice and stabbed him. This was the year of the Homestead strike. We presume that there were many otherwise law-abiding people who would have felt no regret if Berkman's attempt at murder had been successful. The world has since revised its estimate both of Mr. Frick's character and of his part in that famous strike. Berkman was sentenced to twenty-two years in the penitentiary, but was pardoned at the end of seven, Mr. Frick showing the unnecessary softness of heart with which he was seldom credited by signing the petition for Berkman's pardon. On his release, Berkman abandoned the actual commission of anarchistic deeds for the safer course of encouraging others to commit them. He got into trouble occasionally, but it was never very serious. In 1916 he established an anarchist paper 'The Blast', in San Francisco, and is generally conceded to have helped to incite the Preparedness Day murders. Yet Berkman escaped indictment. As a result of opposition to the draft he served a two years' sentence. Finally, a few days ago news of Mr. Frick's death and of the order for deportation of Berkman appeared at the same time. When we try to estimate the amount of harm that Berkman has done since his first release from prison, twenty years ago, there comes a feeling of regret that our Government has been so lenient in the past with men, and women, of his type.

Bulletin on Vocational Guidance

An interesting bulletin entitled 'Vocational Information' has recently been issued by the Committee on Vocational Guidance of Stanford University. It is designed especially to guide students and prospective students at the University in the choice of a vocation but to study it would repay anyone with a choice of vocation still before him. Its 200 pages give a 'bird's-eye view' of the principal occupations a college graduate is likely to follow, including the preparation needed, the general 'working conditions', the range of salaries, and last but

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not least, the special advantages and disadvantages of the particular vocation. It is evident that there has been an earnest attempt to avoid exaggerating the advantages, particularly salary, and glossing over the disadvantages of each vocation, and this attempt, in the main, appears to have been successful. Curiously enough, there is virtually no recognition of the large opportunities for the technically trained man in the metal industries.

The Shipyards Strike

As far as the shipyards are concerned, the principal event of the past month in the strike that has affected shipyards and shops in most Pacific Coast centres was the resumption of work on December 6 at the yard of the Todd Drydock & Construction Company of Tacoma. The strike was called off and the same wages and practically the same working conditions prevail as existed on September 30, with the proviso that if at any future time the Government grants any wage increase, nothing in the agreement shall prevent the men from receiving it. Early in December the California Metal Trades Association commenced advertising for men in cities outside the Bay district. Both yards and shops have been able to increase their forces, but few, if any, have all the men they could use, provided a well-balanced force could be secured. On the other hand, negotiations between the California Foundrymen's Association and the Molders' Union, extending over a period of several weeks, ended December 22 in the virtual surrender of the Association. The men returned to work under the old conditions but with the eight-cent-an-hour increase. It should be remembered that the foundrymen did not present a united front during any part of the struggle. Several brass-foundries did not cease work at all, granting the raise on October 1, and the other commercial brass-foundries fell into line soon afterward. Even before the general reopening of the shops during the week of November 24, some iron foundries had complied with the union demands. The result of the three months shut-down is a bitter pill to swallow, and, as usual, it was brought about not so much by the strength of the union as by the lack of cohesiveness on the part of the employers. The position of the union is economically unsound. The restrictions and obstacles placed in the way of efficient production are too great a handicap to permit the district to grow or perhaps even to exist as a manufacturing centre. It is not high wages but high production costs that the industry has to fear. If low productive efficiency is continued along with the increased wage scale, competition with other districts will be impossible. No permanent good can come from an agreement so obviously wrong in principle. It is to be hoped that better conditions will be conceded by the union in the permanent agreement that is to be prepared, and which will be effective until April 1, 1921. Early in December, several of the manufacturing foundries withdrew from the California Foundrymen's Association and were taken into the California Metal Trades Association, a foundrymen's branch being organized for their benefit. None of these concerns has signed up with the unions. Members of the California Metal Trades Association declare that the agreement made by the foundrymen will make no difference in their own determination to continue operations on an open-shop basis.

Why Not Pull Together

In California, as in other States, we have many commercial organizations. Every 'live' community has its Chamber of Commerce or Board of Trade, the various trades and some of the professions have their local and State organizations, and there are many special organizations such as the California Development Board and the Home Industry League. All of these bodies are intended to be a benefit to the community. Most, if not all, of them are so. Nevertheless, of the several hundred thousand dollars spent each year by these organizations, a large proportion is wasted.

It is wasted partly because the entire amount is divided among so many organizations that the funds at the disposal of any one body are relatively small. With an inadequate staff and inadequate funds at his disposal, the secretary, himself usually inadequately paid, is handicapped at every turn, and fails to get results commensurate with even the small amount expended.

It is wasted partly because, in the absence of any central co-ordinating body, there is duplication of effort by the various individual organizations.

More than all, it is wasted because local rivalries force many organizations to work at cross purposes. In spite of all the lessons about co-operation the world has had, the Jonesville Chamber of Commerce seldom realizes that, if, because of its efforts, a factory is induced to come to Jonesville that could have operated more economically at Smithburg, the result in the end is bad for Jonesville as well as for Smithburg. A most glaring instance of this spirit has been shown in the cities of the San Francisco Bay district in connection with the proposed naval base. Did political and commercial organizations of the various cities, when the news came that a base was to be established in the district, say, "This is a good thing for all of us, no matter what particular situation is selected. Now let us all get together and co-operate with Congress and the Navy Department so that they can select the best site."? Well, not so you could notice. With few exceptions, we know definitely of only one, each community has devoted its energies to promoting the selection of the site adjacent to, or within its boundaries. Public officials have even gone to Washington on the taxpayers' time and the taxpayers' money, to lobby for their special locality. Were these men harbor or marine engineers, able to advise the Navy officials? They were not. They were lobbyists, selected because of real or supposed political influence.

Is it not about time we outgrew this super-provinciality, we will not say 'small-town stuff', because, as we have seen, it is a failing of the large cities as well. We

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spend a dollar on a 'whoop-it-up' campaign to persuade people to buy home-produced goods irrespective of quality or price, and perhaps as much as five cents toward establishing conditions that would permit the local manufacturer to compete with the world on both quality and price. With artificial handicaps removed, the Pacific Coast could meet world competition in most lines at least. If there are any lines in which it cannot, no propaganda is going to hold the market for the home product for long. Even where competition appears difficult, better deliveries and general service may win a share of the market for the local concern where price at least favors the outsider.

Let us forget about free factory sites and bonuses. Given an even break, the capable manufacturer does not need or want such favors. The incapable manufacturer we do not want. But the capable man must have that even break. Let us see that he gets it. Let us place in office men that will not necessarily lower the taxes but who will see that one hundred cents in value is obtained for every dollar paid. Let us work for conditions that will bring about not lower wages, but lower labor costs. Then our industries will be able to stand alone, and to prosper.

The Commercial Federation of California

Several years ago a delegation of business men of Los Angeles went to the State Capital to kill a vicious piece of radicalism that would have put great obstacles in the way of legitimate business, but, to the chagrin of the members of the delegation, they found that they were unknown and without power or influence in the legislative halls, even with the men from the Los Angeles district. Influential though they were in the business world, they were ignored in political circles, while the leaders of organized labor were welcomed like reigning monarchs. Going home on the train, this group of manufacturers discussed the pitiable predicament they were in—the representatives of industry but without influence in their own State. They realized that this position was the result of their own lack of interest in political affairs and of their lack of organization, and they then and there resolved to remedy this situation. From that germ the Commercial Federation of California was formed and through many vicissitudes it has at last become a power in its community. Last year in Los Angeles, it elected twelve out of eighteen legislators, four out of seven school trustees, and seven out of ten city councilmen. It is a political organization, but is not affiliated with any party. Its policy is to back candidates that are honest, and who will work for the best interests of the whole people and against class legislation that will give to any class privileges to which it is not entitled.

During the month of December a flying squadron of prominent business men of Los Angeles made a speaking tour of the prominent cities of northern California in the interests of organizing branches of the Federation. A number of men prominent in the metal industry were in the party. A list of some of these will indicate the standing of the Federation. In the flying squadron were H. M. Haldeman of the Los Angeles Pipe & Supply Co., Reese Llewellyn of the Llewelyn Iron Works, J. S. Craig of the Los Angeles Shipbuilding Co., A. C. Denman, Jr., of the Southern California Iron & Steel Co., and a dozen other men as important in their own lines. At a meeting at the Palace hotel, December 10, Mr. Haldeman, president of the Federation, explained the workings of the Federation and its purposes to over a hundred representatives of the business and manufacturing interests of San Francisco. At the close of the meeting, which was very enthusiastic, a committee on organization was appointed, consisting of A. B. C. Dohrmann, Marshall Hale, Constant Meese, James Talbot, Harold Cook, and others. For the present, headquarters for the Bay district are maintained at 714 First Savings Bank building, Oakland, in charge of J. W. Hunt.

Every thinking man realizes the need of an organization of this sort and if the organization of a powerful branch in San Francisco is prevented by petty jealousy or by indifference, then San Francisco, as a whole, and its industries, in particular, will lose one of the greatest opportunities that they have ever had.

The Federation is not fighting labor, but is making a war upon radicalism. It believes that the interests of Labor and Capital are mutual and that neither class is entitled to gain at the expense of the other. An an indication of its policy one of the speakers told how the Federation used its influence to put a voluntary tax on business in Los Angeles in order that the firemen and policemen could get increases of salary to which they were entitled but which they could not be given under the charter. The Federation publishes a paper and maintains a speaker's bureau to fight the influence of radicalism. It is planned to raise a fund of $200,000 per year for the next five years to be used in defeating radicalism in this State and to put into office and maintain there men of the requisite intelligence and moral courage, men who will give this State a better government and who will serve the whole people. God established the fact that a man is worth more from the neck up than from the neck down and it is high time that the intelligent people of the community and the State take enough part in public affairs to have some voice in the government. It is due to the indifference of the business man that the forces of radicalism, treason, and revolution have become a menace. The time has now arrived when it is necessary for the thinking people to fight this vicious element if they wish to preserve for their children the rights and opportunities which have been handed down to them in trust. Until lately, this Government has been guided at least by the intelligent and the upright and if the reins now pass into the hands of the ignorant and the dishonest through the apathy and indifference of the former, it will indicate that while they were willing to accept the privileges and benefits of this Government, they are unwilling to assume the responsibilities, and they will be themselves to blame for the result.

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Quantity Production Methods for Increasing Foundry Output

By W. S. FALSTBEAU

The time has come when the foundries of the Coast realize that they must wake up if they are to keep pace with the demands of the manufacturer. Never in the history of the foundry have the demands for production and quality of castings been so great as since the development of the automobile pleasure and commercial vehicles, aeroplanes, tractors, and similar machinery.

Having been engaged in the foundry end of automobile construction for the past twenty years, I can remember the trials and tribulations of the foundryman who had the nerve to take on a cylindrical job in the early days. I can remember the pride we felt when we could turn out a dozen single cylinders per day with a loss of only 30%. What a great step forward we considered it when we first started using the old hand roll-over molding machines. Then the squeezer machines were gradually introduced and, as our orders increased in size, metal patterns came into style. I had the pleasure of helping to design one of the first power-jolt roll-over machines made. This machine has been developed into one of the largest lines of power machines on the market today. I know of no better illustration of the old saying, 'Necessity is the mother of invention', than the development of pattern-making and foundry methods to meet the demands of the gas-engine manufacturers. While the demand for duplication of castings is not anywhere nearly so great on the Coast as it is in the East, I believe the day is not far off when our foundries will be compelled to rig up for production or go out of business. Of course, this prediction does not apply to those doing heavy jobbing work only.

In planning foundry equipment there are three principal classes into which I would divide patterns.

First would come the 'one or two casting' jobs, or jobs that will go into the sand for a limited number of castings and are not repeated. There is a good chance here for the pattern-maker to use his judgment, providing he has any. This subject has been in dispute between the pattern-shop and the foundry for a number of years, and to the best of my knowledge has never been settled satisfactorily. A one or two casting pattern may be slighted in a number of ways so as to reduce greatly the cost of the pattern work. This is good practice providing the saving is large enough to outweigh the increased molding cost. Such short cuts as sweep work, skeleton patterns, and core-boxes are too well known to discuss here.

Second comes a class of work where the orders are not large, but the patterns are frequently in the sand, sometimes coming and going for several years. This is the class of work that gives the most trouble. The original order calls for 50 or 100 castings; the customer does not wish to pay any more than necessary for patterns and will protest if special flasks are requested. The original order is gotten out and pattern and boxes have stood up very well; the customer congratulates himself on not having allowed the foundryman to incur the extra expense of elaborate equipment. The next order comes in and the equipment is not in such good shape; castings are not satisfactory; molds and cores require more tooling; molders and core-makers are complaining and the profits are not nearly so large as they should be. Eventually new equipment is required, and if all hands have learned their lesson, the new equipment is satisfactory. On this class of work is the greatest opportunity for good judgment. If the work is a bench-job, there must be enough patterns to fill a snap-flask so that it will not be necessary to run in another job.

At a small increase in cost of patterns, a metal match-plate can be made that will give greater production and better and more uniform castings than can be produced by any other equipment. No mention is made of gated patterns, as the match-plates cost little if any more than a gated job. They require no sand or wood match, practically eliminate tooling the joint and, if properly made, require little rapping, a small vibrator being the ideal means. A foundryman equipped with squeezer machines can slip in a match-plate for 100 or 200 castings and turn them out about as cheaply as he could an order for 5000. The advantages of match-plates hold for any bench-job that is frequently in the sand, irrespective of the number of castings in a mold, or of the weight of castings.

Let us consider next small floor-jobs. By a small job is meant any floor-job weighing not more than 1000 or 1200 lb. and requiring a flask not over 36 by 50 in. It is surprising the number of jobs in this class that are made with cores, which, if cope-and-drag plates are substituted, can be made with green sand. It will be found economical to eliminate all cores possible. On some jobs, in my personal experience, production has been increased 150% and, had the demand warranted putting these jobs on molding machines, the production would have increased beyond any possibility of meeting it with cores, as the oven space required would have been prohibitive.

In jobs of all classes mounted on plates, it is possible to get a cleaner-cut casting, as on a loose pattern the molder invariably has to tool his joint and will not obtain a straight true joint, flush with the joint of pattern. The casting will show a ragged parting-line requiring chipping and grinding. (A plated job can always be mounted on a molding machine with little work.) A noteworthy example of this is in a number of steel-spoked

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wheels run in the Holt foundry. The spokes are staggered on the hub; the rim and hub are gray iron and the spokes are ¾-in. steel. The old equipment consisted of a loose iron pattern and a wood follow-board. The molder would put up his drag and then spend from a quarter to half an hour making his partings. After ramming his cope and lifting it off, he invariably had to tool it as well as tooling his drag after drawing his pattern. The result was a ragged parting line, spoiling the looks of the casting and as he did not care to take chances on a crush, the molder usually had a heavy fin requiring chipping and grinding. This job is now done on cope-and-drag plates and the molder does not have to touch his joint. Production on this job has increased about 250% and the castings are much cleaner and require much less work in the cleaning-room. While special iron flasks are more suitable for this class of work, they are not necessary unless the number on order warrants the extra expense. By having a tight pin on one end and a slot on the other to take care of the variation in wooden flasks, the same results are obtained that an iron flask would give. The old and new methods of handling this work are illustrated in Fig. 6, 7, 8, and 9.

In eliminating cores on many jobs it is necessary to reverse the usual molding methods. Take, for example, a transmission cover, requiring a flask 8 by 40 by 48-in. drag, and a 30 by 40 by 48-in. cope. The metal thickness is ⅜ in. and all the casting, which is about 24 in. high, is the cope. It is gated on the top and trouble is never experienced, either in running the casting or with dirt. When you start mounting patterns on plates, it is surprising how many jobs you will find adapted to this method and the number of jobs that can be made from green sand, which formerly required cores. While I have seen a number of jobs made from green sand, using shell patterns, I consider it poor practice, as it is a slow method, and, even with metal equipment, the patterns are continually getting out of shape.

In the third class come all large-production patterns. While on the Coast this field is limited to a few plants, principally tractor and automobile-truck factories, and to a small amount of plumbers' and builders' hardware, there are few firms that are taking full advantage of proper equipment and molding machines. I can see no necessity for the Coast trade purchasing plumbers' supplies and builders' hardware in the East. It is true that the cost of raw material is higher here than in the East, but with the same foundry and machine-shop methods here, I see no reason why we cannot supply our own needs. And if we cannot compete with them, using the same methods, it is up to us to improve on their methods.

The first requirement for large production of castings is good metal patterns and core-boxes. I do not mean any kind of castings with the gates and fins knocked off, but a casting which has been laid out with the care and precision a good pattern-maker puts into a good wood pattern—a job where every advantage has been taken of the possibility of machining the pattern, ensuring perfect dimensions and smooth surfaces—a pattern where proper draft has been allowed and which when put in the sand will draw smoothly and improve with age, as the constant ramming of the sand will tend to keep it polished and make it smoother the longer it is used. A metal pattern or core-box will wear out in time, the same as any other equipment, but I have seen metal equipment from which 60,000 automobile-cylinders have been made, and which was in good condition and true in every respect.

Given good patterns, the next requirement is suitable molding machines. There are a great many types of machines, but there is usually one that is better than the rest for a certain class of work. Judgment must be used in choosing your machines. While these machines are called molding machines, they have an important place in the core-room. There are few core jobs where some type of machine cannot be used to advantage. I have in mind a cylinder-head on which the first requirement is accuracy. It is mounted on a small hand roll-over machine, and while the production is greater on the machine than on the bench, the largest gain is in accuracy of the cores. There are six small prints that carry the jacket-core, and, to obtain a good casting, these prints must be perfect. While it is possible for a good core-maker to draw this box and obtain a good core, he cannot obtain such a result every time. With the machine it is no trick at all to roll the box and with the aid of the small vibrator in the machine, obtain a perfect draw every time. By the use of metal boxes and this machine, the cores never vary and the loss is low. Iron core-driers are used wherever possible, thus saving the sand and time necessary to bed in these cores. As these cylinders and heads are produced in large quantities, special iron flasks are used for these jobs. While one is broken occasionally, they never burn out and they stay true on the joint and the pin-holes.

As an example of what molding machines will do toward increasing production, previous to mounting cylinders in the Holt foundry on a jolt stripping-plate machine, the production was about 30 per day. Losses were high and castings were not uniform. The patterns were parted on the centre of the barrel and molded flat, but were stood on end for pouring. When building new equipment, 100 flasks were ordered. Four flasks were scrapped in machining, leaving 96 good flasks. The men on the cylinder-floors came in early, and inside of ten days were putting up 96 cylinders per day in about six and one-half hours. One man worked on the cope and one on the drag. They helped each other set off the molds, set their own cores, closed and clamped the molds ready for pouring. The castings were poured flat, using a skimmer-gate, and the loss was not over 2%. Because these castings were uniform and true to pattern, the machine-shop production was greatly increased. As these men were on piece-work and were going home about 1 o'clock, it seems certain that 125 molds could have been put up per day.* Six-block cylinder jobs have been

*For a more detailed description of the making of these cylinders, see 'Metal Trades' for November 1919, p. 513.—Editor.

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rigged up where three men working eight hours have put up 115 molds per day.

To show what a change of pattern design will sometimes do, it will be of interest to note the experience with one job that takes a four-part flask, the cope and drag being about 32 in. diameter by 10 in. deep, and two cheeks about 12 in. deep. This job was formerly made of steel and while patterns were kept in three foundries at a time, there were never enough castings to supply the needs. These foundries each delivered about three castings per day, sometimes less. A few were made in iron in the Holt foundry, and as these were made the same way, using three men on the job, production was no better. Losses were high all around. Finally, all these casting were made of iron and, as a large number of the castings was desired, improved methods were adopted. By putting this job on four match-plates and building special flasks, production was raised to ten molds per day with two men, and the loss was around 2%.

During the War, through the aid of molding machines, production was increased on crank-cases from about 3 per day on the floor to as high as 32 per day on the machine. These castings weighed about 950 lb. with an average metal thickness of ½ inch.

Let us now consider in detail the pattern and foundry equipment on a few sample jobs in the different classes:

Referring to the plate of patterns in Fig. 1: This job consists of 12 metal patterns on a steel plate and is run in a 12 by 12-in. snap-flask. It is a simple job, as there is nothing in the cope except the runner. A great many foundries used to run jobs of this kind from gated patterns, and some still follow this practice. Where hand-ramming is used, this practice cannot be compared with the plated patterns. With a gated pattern it is necessary to use a match. The molder will ram his drag and roll his job, draw his match and then tool his parting. Theoretically, with a good match properly made, tooling the joint is unnecessary, but I have never seen a match of this kind. Next he rams his cope. Now, if he has any lift in his cope, it is necessary to rap his pattern through the cope. Providing he gets a good lift, his next operation is drawing his pattern from the drag, depending on a couple of $\frac{3}{16}$ or ¼-in. steady pins to give him a good draw. Very few molds are made from gated patterns that do not require tooling on the joint. Often because of an irregular parting, the molder will fin his joint to be sure he does not get a crush. This means extra work in the cleaning-room and a poor looking casting. Due to a variation in the rapping of the patterns, castings vary in weight. Using plated patterns eliminates most of this trouble. In the first place, you have no match, the plate itself forming the match. The plate being even in thickness does away with any chance of fins or crush. A small vibrator fastened to the plate itself gives all the rapping necessary without distorting the shape of the mold. The vibrator is working while the cope is lifted and the pattern drawn, giving better results than when another man raps the bench or tub during this operation.

Now we come to operating the same job on a machine. For this class of work the plain power-squeezer is adapted to the largest variety of work. There are a number of jobs with deep draws or small pockets on which a combination jolt-squeezer will give better results, but plain squeezers serve satisfactorily on all of the work at the Holt plant.

Using plain squeezers the operations are as follows: The molder sets up his flask with the plate between drag and cope, drag side of mold up; fills the drag-flask with sand; strikes off the excess sand; and places the bottom-board. The bottom-board should be small enough to allow for squeezing into the flask. He then rolls the flask and fills the cope-flask with sand. He now swings forward the squeezer-head, which has been backed out of the way. (The squeezer-board should have the pouring-basin pattern fastened permanently in position so that when the mold is squeezed, it will form the basin in the mold in proper position.) He now turns on the air, and when the gauge shows the pressure previously determined as the right amount for this particular job, the air is turned off. (Squeezing a mold takes about five seconds on an average and both cope and drag are done at once.) He then throws back the squeezer-head and turns on the vibrator, lifts his cope, and sets it on the cope-rack at the left. He next draws his patterns and sets the plate on lugs for this purpose on the head of the machine. It is seldom that the mold requires tooling if the pattern-plate is what it should be. He is now ready to set his cores if the job calls for any, close his cope, and set the finished mold on the floor. The average production from power-squeezers is 125 molds per man for eight hours work. However, as high as 225 molds in a flask 12 by 14 in. with a 5-in. cope and drag are frequently put up by a single man.

Fig. 2 shows the drag-side of a heavy crank-shaft bearing-cap. This job is made on a plain squeezer machine. As shown in the photograph, the pattern is so made that green-sand core is raised about 1¼ inches in the cope. This method makes the use of soldiers unnecessary and avoids trouble with drops, which might occur when the green-sand core is below the flask joint and soldiers are used. Many foundry foremen say that a pattern with a deep lift or draw cannot be used on plates, as the molder cannot see his pattern and mold in drawing the pattern. In my experience, no trouble has ever been encountered with plate jobs having a lift and draw up to six inches. By using a vibrator on the plate, the pattern is rapped absolutely uniform and just enough to free itself, giving a mold in which you can feel the draw much better than with a hand-rapped job. You also have the flask-pins that act as steady pins on your plate and, as you have a solid contact between pins and plate, you can draw the pattern much truer than with the small steady-pins on a gated job.

In this connection, I would mention that a jig is used in laying out pin-holes in the pattern-plates. This jig is simply a bar of cold rolled steel about ½ by 2 by 24 in. with one snap-flask pin doweled and bolted to one end. This pin is never moved. The second pin is doweled at

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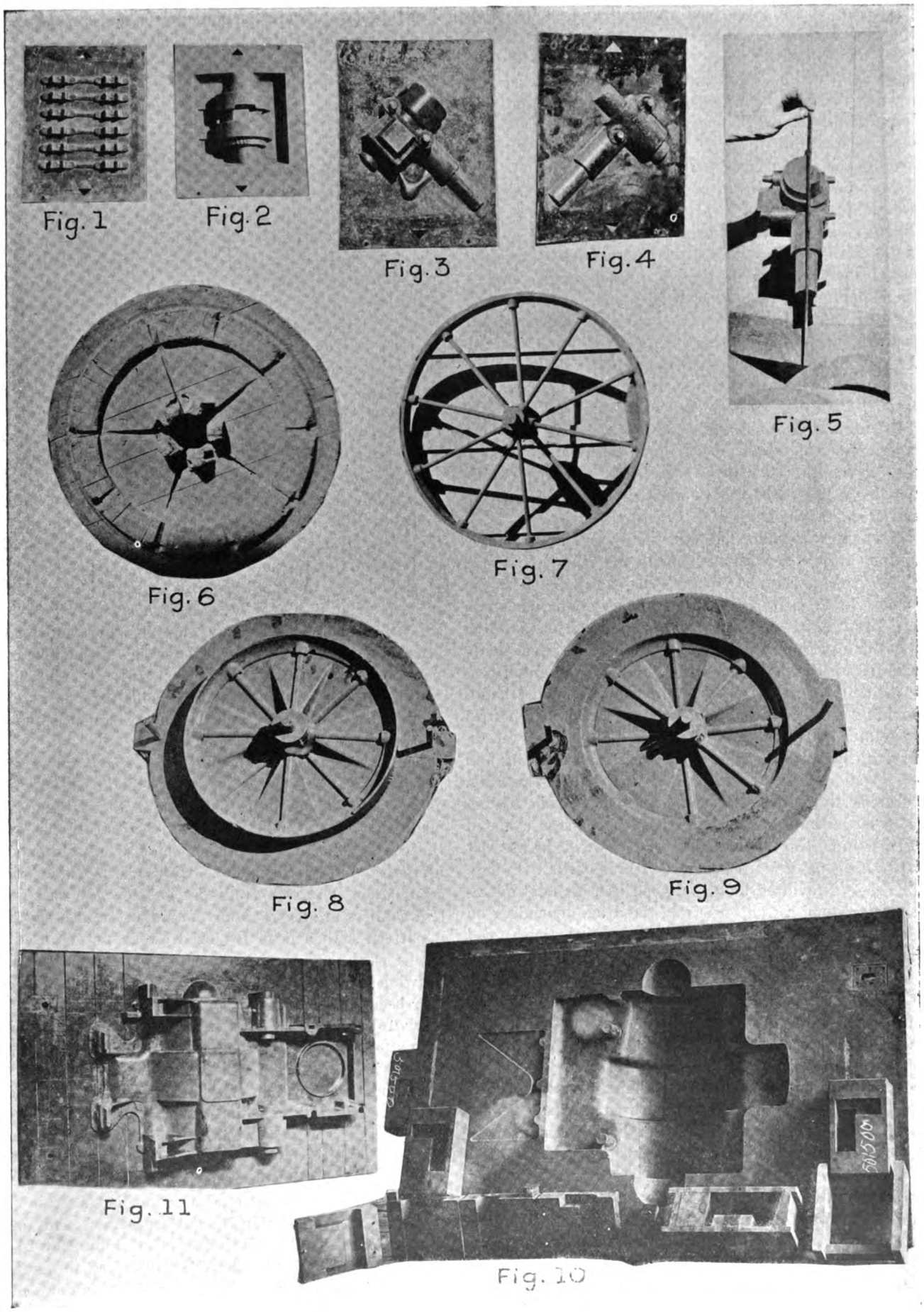

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the proper distance to suit the different-sized flasks. This movable pin is placed in the dowel-holes corresponding to the size flasks in which the job is to be run, and is held rigid by means of a machine screw and wing-nut. The pin-holes in the plates are then fitted to this jig. The pins on our flasks are all set to a female jig that matches our plate-jigs. Consequently, any plate of one size will fit any flask of that size without being loose or crowding on the pins.

Fig. 3 and 4 give drag and cope views of a simple plated job and show the gate. Fig. 5 gives a view of both cope and drag and gives an idea of the depth of draw and lift. While the vibrator used on this job cannot rap the job enough to enlarge the mold, no trouble whatever is found in getting a clean lift or draw.

In concluding my remarks on this class of work, I would say that I never saw a bench-job that could not be made on match plates to better advantage than loose or gated.

I would now call attention to a different class of match-plates. The main difference is that cope and drag have separate plates, and this method is used for larger work. Fig. 6 and 7 show the equipment formerly used for one job in the Holt foundry, a loose iron pattern and a wood follow-board. This is admittedly a poor follow-board, however, you can plainly see the unnecessary work the molder had to do in making his parting. Even with the best of follow-boards or matches, he would have a great deal of unnecessary work and tooling to do on a job of this kind.

Fig. 8 and 9 show the present equipment. Orders for this part call for 100 or 200 at a time and are not large enough to pay for making many flasks or for putting the job on power machines. However, with the new pattern equipment, 30 flasks were made. As the cope and drag match perfectly, the molder has no tooling to do. The spokes are brought to him with the ends red-leaded to prevent the metal from kicking and he simply drops them into his drag the same as so many cores and closes his mold ready for pouring. This method not only saves the molder's time, but cuts the cleaning cost to practically nothing, as it gives a much cleaner casting, with no fins to chip and grind. While only 30 pieces per day are produced of this job on the floor, if the requirements warranted building the flasks and putting the job on power-machines, 125 per day could be made by two men. You cannot realize how many jobs are adapted to this method of molding until you try out one or two and then find job after job coming into the shop on which you can see that production and quality would be increased by this method.

Another example of this method is seen in Fig. 10. On this job cope-and-drag plates are used, as on the job just mentioned, but while the old practice was to make castings of this kind with a dry-sand core, every effort is now used to make jobs of this kind with green sand. This pattern takes a flask 40 by 54 in. with a 14-in. drag and an 8-in. cope. As can be seen from the illustration, a cover-core would have to be used if the job was made with cores as the only core supports are the two bearings, one on either side of the casting. This would necessitate a core about 10 by 36 by 48 in. About 20 per day will be the output for this job when it is in production. It can be plainly seen what a problem would be presented in the core-line. The cover for this part is the same width but about 10 in. shorter while it is about 24 in. deep, requiring a cope 30 in. deep. The same number of covers are required as bottoms. While it is not intended to run these two jobs at the same time, the oven space required for either one of these jobs is indicated by the size of core and the number required.

On the pattern illustrated, the green-sand core is in the cope, while on the cover the core is so deep that the molding method is reversed and the core is in the drag. On both jobs, wooden flasks and bars are used at present, but when the job goes into production, iron flasks will be used and the job run on power-jolt and power roll-over machines. As there is only one machine on the floor large enough to handle this flask, it will mean that the drags will have to be rammed first and the patterns then changed to ram the cope. It takes about 20 minutes to change patterns on this machine. With metal flasks properly barred, very little nailing or securing is required. Many jobs require no securing whatsoever.

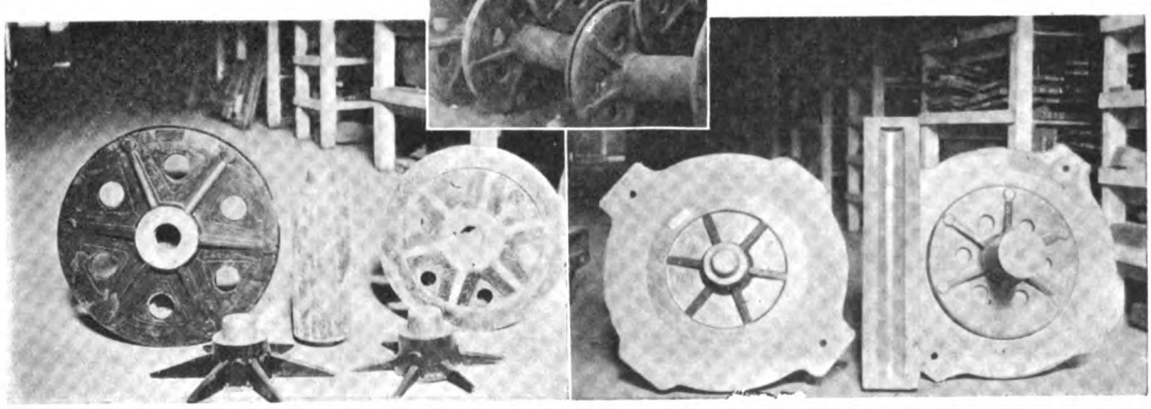

FIG. 12, 13, AND 14. FINISHED CASTINGS AND OLD AND NEW TYPES OF PATTERNS

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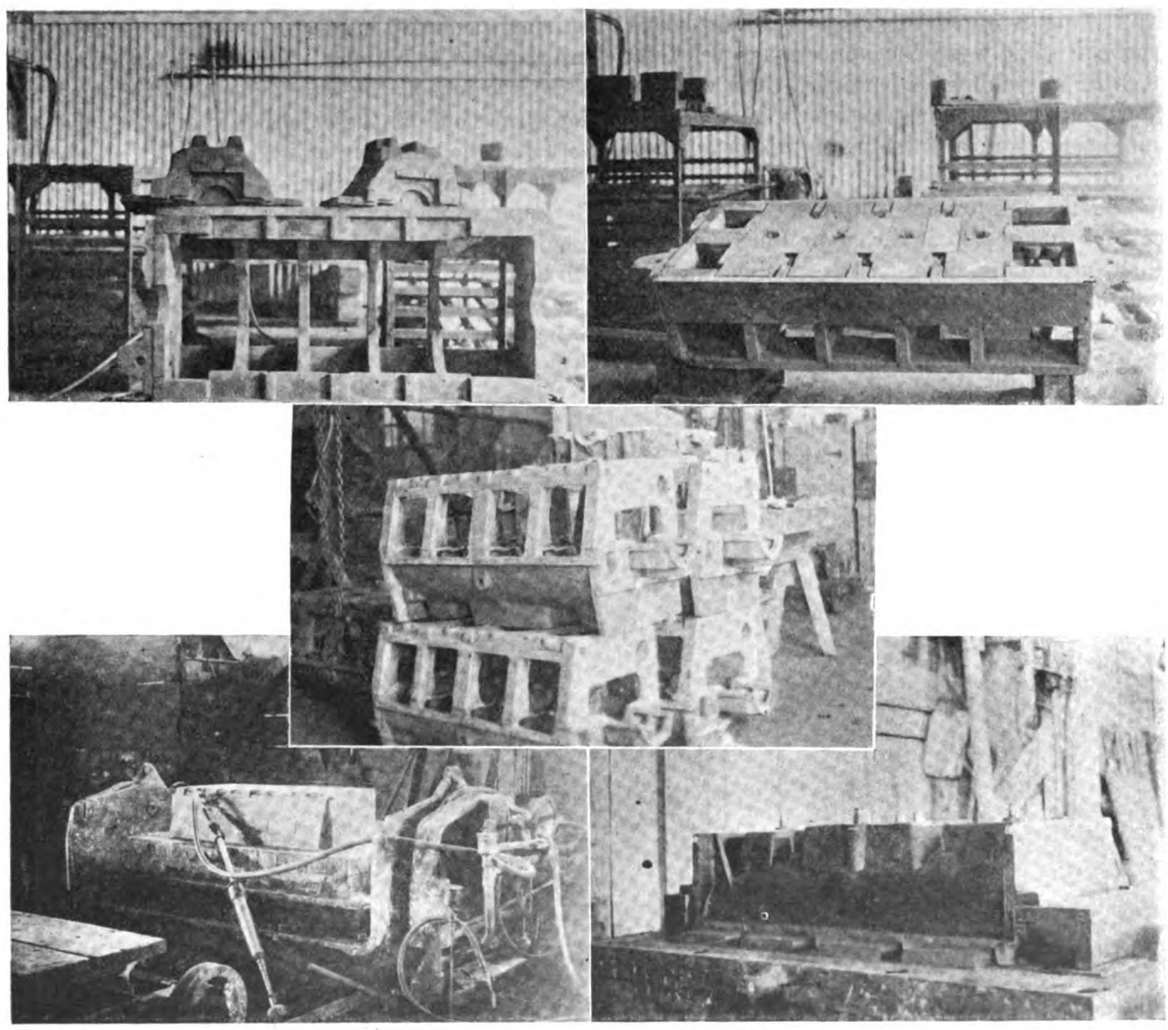
On the job illustrated, four small cores are used, three for bearings and one for an undercut. The position of these cores is shown in Fig. 11.

A large number of jobs made at the Holt foundry have been changed from dry-sand to green-sand cores. In fact, just previous to starting this green-sand policy, the company was making plans to build two more ovens as the core requirements could not be met. Today there are two less ovens than at that time and they are not overcrowded. In every case where a change has been made from cores to green sand, increased production and better quality of castings are the result.

Fig. 12 shows part of a pile of castings of a piece that were formerly made of steel. At times a few were made of iron in the Holt foundry, using the same methods as the steel foundries. The Holt Engineering Department then changed its specifications and called for gray-iron castings. The pattern equipment formerly used is shown in Fig. 13. The difficulties in molding this job with the pattern shown are easy to see and, as at least eight castings per day were required and the losses were high, a new method was essential.

It seemed that the proper way to make this job was on match-plates, and as the orders had become large enough to warrant new patterns and special flasks, four plates, a drag, two cheeks, and a cope were made. Fig. 14 shows the drag and one cheek-plate, also the core-box. As the flanges were not the same diameter, it was necessary to make four plates. Had both ends been the same, two plates would have been all that was necessary, as the drag would do for the cope and one cheek would do for both.

Care must be taken in laying out pin-holes in the plates and in drilling the flasks, for if the pin-holes in the plates are not accurate, the castings will show a shift and will be out of line. As it is a four-part flask and each part double-lugged, accurate drilling is required to align the four parts without binding on the pins or with no shift in the flasks. Pins 1 in. diam. and about 48 in. long are used with the pins going through all four parts of the flask. As can be seen in Fig. 14, the ribs on this job are equally spaced each side of the pin-centres, and pin-holes are an equal distance from the hub-centre, so no shift can occur because of turning the flask end for end. In fact, there is nothing on the job to show which way to close the flasks. Two men are kept on this job.



IN CENTRE, PILE OF CRANK-CASES FOR TRACTORS. THE OTHER ILLUSTRATIONS SHOW DETAILS OF PATTERNS AND MOLDING. FOR DESCRIPTION SEE TEXT.

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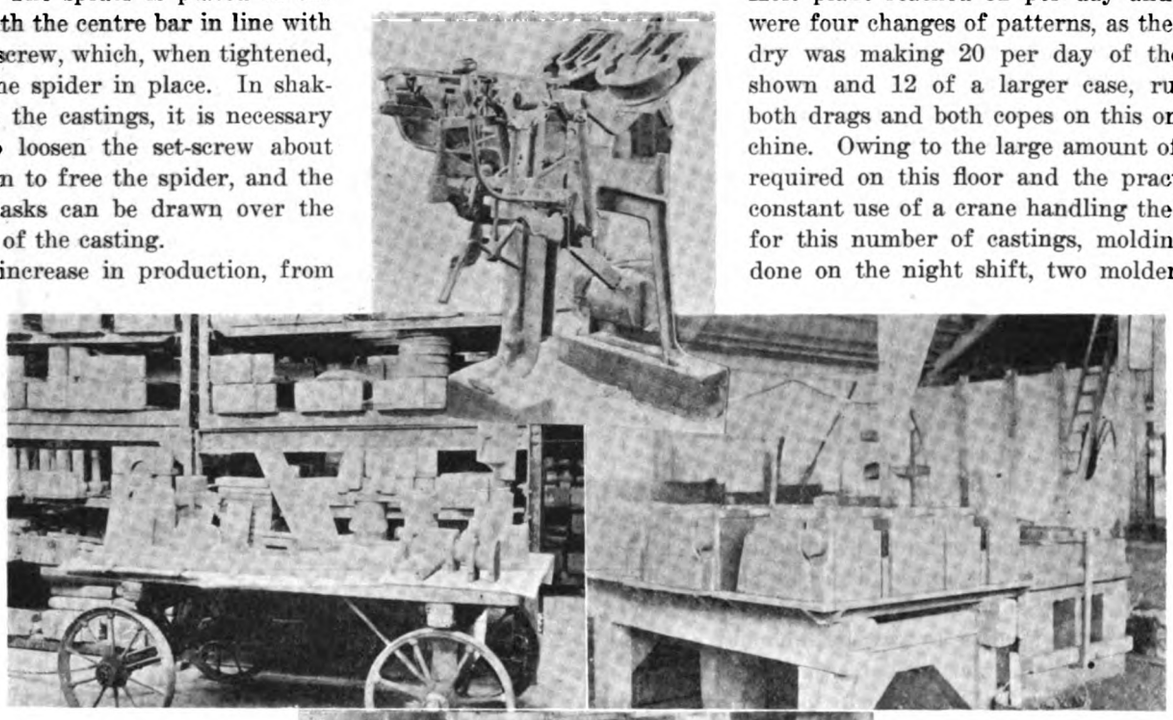
and, working piece-work, they put up ten for a day's work.

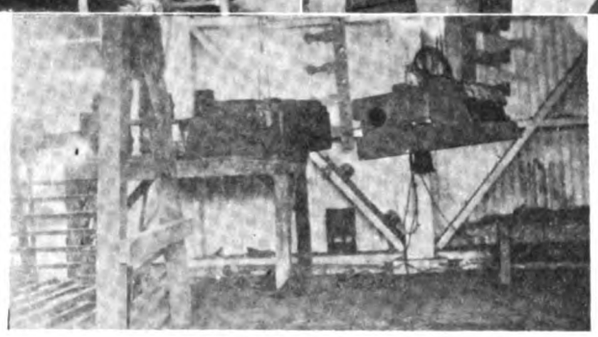
The flasks are iron, about 32 in. diam. Drag and cope are 10 in. deep, the two cheeks being about 12 in. deep. The cheeks require bars and as with tight bars, the casting would not come out of the flask, a cast-iron spider is used made in halves. This spider fits fairly close to the flask and rests on the sand-strip in the flask. It consists of a ring with a diameter about four inches larger than the hub of the pattern. The ring is made in halves, and each half has three bars. The cheek-flasks are drilled and tapped about the centre of their depth for a ⅝-in. set-screw. The spider is placed in the flask with the centre bar in line with the set-screw, which, when tightened, holds the spider in place. In shaking out the castings, it is necessary only to loosen the set-screw about one turn to free the spider, and the cheek-flasks can be drawn over the flanges of the casting.

The increase in production, from two and three castings per day from three men to ten castings per day from two men, was due entirely to a change in pattern equipment and flasks, as this job is not run on the molding machines. With this job on suitable molding machines, three men could turn out 40 per day.

The central photograph of the group on page 10 shows a few crank-cases for tractors. These castings weigh about 950 lb. each and take a flask about 18 by 30 by 52 in., cope and drag. As there is but one molding machine large enough to run this job, it means that the drags must be put up first, then change patterns and put up the copes. The drag-half of the pattern is seen in the lower right-hand corner and the cope-half is shown, mounted on machine, in the lower left-hand corner. This machine jolt-rams the mold, rolls it over and lowers it on the carriage shown at the left, which is rolled under mold. The clamps are then removed and pattern is drawn by machine. Carriage and mold are then rolled back in position of carriage shown at the left. Pattern and machine are then dropped back into position, as shown, ready for another flask. As the pattern and pattern-plate weigh about 1200 lb. and the cope flask alone weighs about 2600 lb. the machine has some work to do. The air-rammer shown in front of the machine is used for butting off the mold, and this is the only operation not performed by the machine.

During the War the production of crank-cases in the Holt plant reached 32 per day and there were four changes of patterns, as the foundry was making 20 per day of the case shown and 12 of a larger case, running both drags and both copes on this one machine. Owing to the large amount of sand required on this floor and the practically constant use of a crane handling the flasks for this number of castings, molding was done on the night shift, two molders and two helpers putting up these molds. Four men on the day gang blacked and cleaned the molds, set the cores, closed and clamped the molds and built the runner-boxes ready for pouring.





ON LEFT, CORES FOR CRANK-CASE JOB. ON RIGHT, COPE-CORES FOR THIS JOB. BELOW, METHOD OF HANDLING COPE-CORES. ABOVE, INTERNATIONAL ROLL-OVER MOLDING MACHINE.

There are four pipe-cores, as well as a few smaller cores, that require securing with chaplets on this job. The drag-cores are tested with jigs to see that they line properly in the mold. The cope-core is set with a jig. In the upper left-hand corner are two of the main drag-cores on a core-jig. Four of these cores are required for a mold. In the upper right-hand corner are a set of these cores assembled in the jig. The top surface of these cores is struck off to ensure a true surface and as the cope-core is jigged also, it bears evenly on all drag-cores. There are ribs in this jig, as shown at the left that indicate the thickness of metal around these cores.

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On page 11 on the truck at the left are shown a number of cores that go with this job. A few of these slab-cores are rammed in the mold to prevent the metal from cutting and the two bearing-cores shown at the right are pasted in the cope-core. The rest are set in the drag. At the right are a few cope-cores ready for the oven. These cores are handled from the racks shown, to the oven-racks by means of a one-ton crane and when taken from the oven are hung up, as shown in the lower centre. The core on the right shows the core-jig in place for striking off the bottom of core and seeing that the cam-shaft bearings are properly aligned. Hanging on the wall are shown two jigs for testing the cylinder-openings. The insert shows a small International roll-over machine with two cylinder-head jacket-boxes. This machine speeds up production by relieving the core-maker of most of the heavy work in handling his core-box and gives a perfect core by means of the mechanical drawing of the core-box.

In closing, I wish to say that I do not want the reader to get the idea that the use of molding machines will do away with all foundry troubles or that they increase production merely by having them in the foundry. In installing molding machines, the line of work handled must be studied and machines chosen that are adapted to the greatest number of jobs; the pattern and flask equipment must be suitable for the machine. The gating has as much to do with the success of the job as any part of the foundry practice. The condition and temper of the sand must be watched closely and every effort made to arrange the molding floors and the delivery of cores so that the man operating the machine can put in the greatest possible amount of time into the production of molds.

Hoping this article may awaken interest along this line, I stand ready to renew the discussion at any time.

A CERTAIN PHYSICIAN was called to the telephone some time after midnight and listened, half asleep, to the following:

"Oh, doctor, come over quick. Willie is awful sick. He can't stand; he can't sit; he can't lie down; he—"

"Coming right over," cried the doctor, adding, "and tell Willie to roost till I get there."

"AH, HA!" said the head clerk. "I'm glad to notice that you're arriving punctually now, Mr. Slocombe."

"Yes, sir. I've bought a parrot."

"A parrot? I told you to get an alarm-clock!"

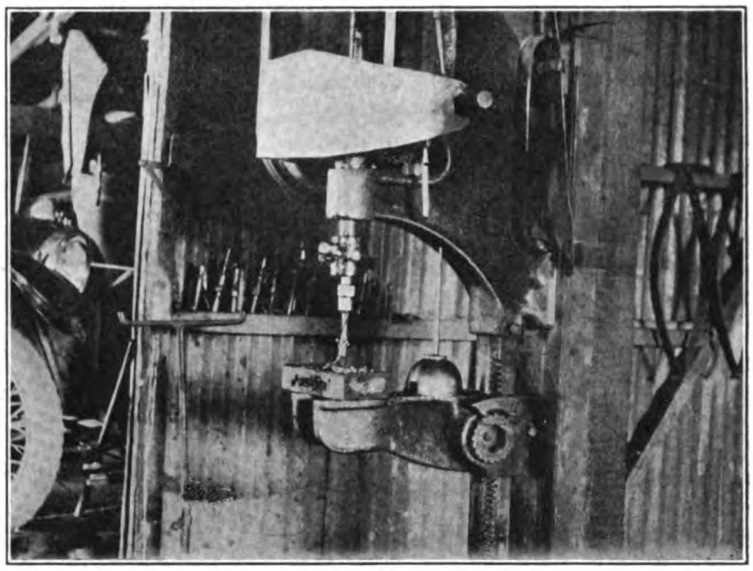
"Yes, I did. But after a day or two I got used to it, and it didn't wake me. So I got a parrot, and now when I go to bed I set the alarm-clock and put the parrot's cage on top of it. When the alarm goes off, it startles the parrot, and what that bird says would wake up anybody."—Los Angeles Times.

Safeguarding a Post-Drill*

By C. FRED TOKLAS

A machine-tool in common use, especially in the smaller shops, which does not come equipped with guards, and, as a rule, is not so equipped after installation, is the post-drill. There are three parts of this tool that need guards, namely, the pulley, gears, and the set-screw that acts as a chuck.

The accompanying photograph shows how easily all three points of danger can be guarded. A light piece of sheet-metal fastened to the frame effectively guards the gears, pulley, and belt from contact by the operator. It is not always feasible to use a countersunk (or safety) set-screw for holding the drills. When a projecting set-screw is used the device shown guards it, and yet does not interfere when tightening or loosening the set-screw. The guard is a ring large enough to clear the set-screw, and pivoted to the chuck so that it can be tilted to permit getting at the set-screw. Guarded in this way, a post-drill can be made equally as safe as any machine in the shop.



WELL-GUARDED DRILL. NOTE ESPECIALLY THE RING COVERING THE SET-SCREW ON THE CHUCK

A Red Cross Public Health nurse in a southern town has found the latest novelty in names for babies. She was weighing a little black youngster.

"What do you call your baby," she asked the grinning young mother.

"Weathah-strips," replied the parent.

"Weather-strips," exclaimed the nurse. "What's the idea, Mandy?"

"We done named her Weathah-strips 'cause she kept her papa outa de draft."

*From 'California Safety News'.

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The Function of Oil-Burners in the Operation of Furnaces*

By HENRY J. N. VOLTMANN

The natural advantages of oil fuel have led to the development of many appliances designed to further its use, the most common of which are the so-called 'oil-burners'. In the early days of burning oil it was generally assumed that the most essential requirement was an 'efficient oil-burner', and such opinion is still quite common even though years of development have conclusively proved it to be in error. This assumption is responsible for a general misunderstanding of the real principles involved, and has in no small measure retarded progress in the efficient use of oil fuel. It has also retarded progress in the development of heat-treatment work, largely because there is no proper appreciation of the difference between 'burning oil', 'making heat', and 'applying heat properly to produce a uniformly heated product'. The last is the result actually desired, everything else being a means to that end.

Fuel-users do not appreciate the difference between 'burning oil', 'making heat', and 'applying heat properly to produce a uniformly heated product'. The latter is the result actually desired, everything else being a means to that end.

Generally speaking, there is no such thing in industrial heating as an 'oil-burner' in the same sense as a gas-burner or the burner of an oil stove or lamp. The very term is a misnomer, because the type of 'oil-burner' generally used for furnace-work is not an appliance to burn the oil, but merely a regulating, mixing, or atomizing valve to inject the fuel and air into the furnace, where it is actually ignited and consumed. The oil itself does not burn; it is a mixture of gas and air that ignites. The gas from the oil generally used for fuel is generated under the action of heat at high temperature in the zone of combustion. The air may be supplied through or induced by the burner or in some other manner, and the supply must be regulated in proportion to the fuel to obtain proper results.

The ordinary oil-burner has about the same relationship to the operation of a furnace that a carbureter has to the operation of an automobile. In fact, the function of the carbureter is the more important for the reason that it 'fixes' the combustible mixture of oil and gas, while the oil-burner does not. The combustible mixture in a furnace is generally formed after the fuel and air leave the burner. It is the design and operation of the furnace, and not the burner, whether it be for oil or gas, that determines the nature of the combustion, the manner in which heat is applied to the heating-chamber, the amount of fuel required to heat the material, and the uniformity of temperature throughout the mass to be heated.

The real 'efficiency' of an oil-burner is mainly mechanical, as with any other type of spraying, injecting, or mixing valve. Some types of burners may produce better results than others in atomizing or mixing, or from a detailed standpoint offer greater convenience of cleaning, adjustment, interchangeability of parts, etc., but in general the efficiency is more dependent upon mechanical than upon thermal considerations. At any rate, the fuel consumption is determined primarily by the requirements of the furnace, and is largely influenced by the method of operation and not by the mechanical details of the burner itself. A great deal of oil is burned successfully in certain types of furnaces without the use of oil-burners at all; in others, the operation is conducted with air-pressures so low that there is practically no atomizing effect from the burner, which serves merely to inject the air and fuel; and excellent heating results, with material reduction in fuel consumption, have been produced with furnaces of improved design operated with burners that have been in constant use for over twenty years.

There are some special forms of oil-burners, such as torches for brazing, drying, lighting cupolas, spot-heating, etc., with provisions for maintaining combustion after a gas has been generated by heat and ignited, but these differ from the type generally used in connection with furnaces and designed by the term 'oil-burners'. On account of the high temperature necessary for the combustion process, and the resultant expansion, contraction, and oxidation, these devices burn away in time; and while adapted to these specific heating operations, which cannot well be conducted with a furnace, their use is unnecessary and unwarranted for general furnace operation.

A properly designed oil-furnace is in reality a combination of a gas-producer and a furnace and should be considered as such. The oil generally used for furnaces must be converted into a gas before it can be consumed, and this gasification process is conducted at a temperature too high for ordinary metal to withstand. When the nature of the heating operation and the design of the furnace will permit the gasification of the fuel within the furnace, it is desirable that the work of gasification be conducted in a chamber lined with refractory material. This refractory combustion chamber is necessary on account of the temperature that must be employed to

*Abstract from 'Journal' of American Steel Treaters' Society.

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actually gasify and consume the oil without deposits of carbon or tarry matter, which naturally follow any attempt to gasify oil at low temperatures. With the oils employed as fuel for furnace operation, the high heats are absolutely necessary because it is impossible to form the gas by mixing the oil and air, or by mixing air with the vapors of the oil, as in automobile practice, on account of the fact that these oils can be but partly gasified without heat.

Years ago it was thought necessary to convert the oil into a gas and deliver the fuel as gas to the furnace. The unnecessary complication gradually brought about an appreciation of the fact that with proper design and operation of furnaces this work of gasification could be accomplished in the comparatively small space occupied by a suitable combustion-chamber, without any loss of heat outside of the furnace in gasifying the oil, difficulty in starting, and risk or discomfort to the operation by radiation or contact with the gasifying equipment or by the explosion-hazard incident to the movement of combustible mixtures through pipes. For these reasons, if the nature of the heating operation and the size of the furnace will permit the use of oil, it is better to gasify the oil at high temperature in a refractory combustion chamber within the furnace; but when the nature of the heating operation and the size of furnace make it desirable to employ a gaseous fuel, then that gas should be generated in a central station at a point distant from the furnace, and the gas, whether it be made from coal or oil, should be scrubbed of its tarry matters so that it may be delivered as a clean cold fuel through a pipe, after the manner of the gas service in cities.

There is no one type of burner suitable for all heating requirements. The essential features are that it be properly proportioned for the oil and air or steam pressures available, and so designed that all parts are accessible and permit of close adjustment, cleaning, and convenient removal from the furnace without affecting the operation of any other burner served by the same piping system. The position of the burner and arrangement of piping are determined by the design and position of the furnace.

Whether the oil-burner be of the high-pressure type using steam or compressed air, or the straight low-pressure type using moderate air-pressures, or of the combination type, the same general rules apply.

There are no fixed rules that can be laid down to determine whether air or steam should be used or the pressure at which it should be delivered, as the specific operating conditions of each case, coupled with the design of furnace, determine these points. The real test is in the effect upon the finished material and the total cost of installation and heating operation.

There are certain cases for which steam, even at a higher cost, is well adapted, but the conditions determining the use of steam are based upon the ultimate result in heated product and not upon any combustion condition. When steam is employed, it must be as dry as possible and all lines must be well-covered and trapped to eliminate condensation. Higher pressures are more necessary with steam than air, not because the pressure is necessary for atomizing, but because steam at a fairly high pressure will be comparatively dry when expanded at the burner-tip. The presence of water seriously affects combustion, the character of heat in the working-chamber, the brickwork of the furnace, and also increases the operating cost. The use of steam with a properly designed and operated furnace gives excellent results, with soft even heats, for certain classes of work. It requires more attention than air, but, when the operating conditions make it desirable, the difference in results is well worth the extra attention. The use of steam is limited to certain types of furnaces by reason of the space required, temperature or other manufacturing conditions, and the necessity for inducing and controlling the air to support combustion.

Steam gives excellent results for certain classes of work. It requires more attention than air, but, when the operating conditions make it desirable, the difference in results is well worth the extra attention.

There is no one air-pressure or type of blower suitable for all conditions. The use of air at pressures above 4 or 5 lb. per square inch involves the use of piston-driven compressors or other expensive water-cooled equipment, which are objectionable on account of the high cost of installation and operation. When the furnace equipment is small and compressed air is available, high pressures may be employed to avoid the installation of new blowing equipment; but, as a general rule, in a new installation involving machinery to deliver air, the higher pressures are unnecessary. In some cases, when the design of the furnace permits, air at 4 or 5 oz. or less per square inch may be employed to maintain clear fires without smoke or carbon deposit; in others, the design of the furnace makes it necessary to employ higher pressures in order to secure sufficient atomization of the fuel. When the very low air-pressures are employed there is practically no atomizing effect, the air acting merely to support combustion and assist in the delivery of oil to the combustion-chamber, the gasification being almost entirely brought about by heat and the action of the gases within the furnace.

The proper air or steam-pressure to employ is determined by local plant conditions and furnace design. Each case must be considered on its merits. The purpose should be to adapt the existing equipment to the furnaces whenever possible, so that the question in each case boils down to accomplishing the final result in heated product at the lowest cost of installation and operation.

High oil-pressures are frequently employed for mechanical atomization of the oil without the use of air to assist in the atomizing process. This practice is common on marine and other large boilers for steam generation, and has many advantages where the consumption per burner is relatively high, where the oil is of low gravity, and where the requirements for raising steam do not demand the refinement and control that is necessary for

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modern heat-treatment processes. The advantages of mechanical atomization in such cases do not hold good in the average heat-treatment plant, where with properly designed furnaces the desired results can be secured without the mechanical equipment and high pressures necessary in boiler work. In average heating practice the actual pressure is not so important as the uniformity of flow, because there is a material reduction in pressure at the needle-valve of the burner, so that the pressure of the oil as it enters the furnace is invariably less than the pressure on the line. A slight variation in oil-pressure will react more readily on furnaces where the consumption is relatively small than on steam-boilers, where the pressure on the line is controlled by a regulating valve.

In average heating practice the actual pressure is not nearly so important as the uniformity of flow.

The combustion of oil is based upon the same principles as those governing the operation of an ordinary coal or gas stove, gas or oil lamp. It is essential that provision be made to regulate the supply of air in proportion to the amount of fuel required to produce the proper heat. If this is not done, improper combustion is likely to occur, due either to insufficient air for the amount of fuel injected into the furnace, or an excess of air beyond that necessary to complete combustion. It may react in a waste of fuel because of the necessity of injecting more fuel than is required for the heating operation in order to balance the excess air drawn into the furnace. This is what generally happens without proper control of all air entering the furnace. As the supply of fuel varies from the time of starting until the furnace is up to heat, it naturally follows that the supply of air should vary with the fuel, and that means be employed to effect such variation. The burning of oil or any other fuel without provision to regulate every cubic foot of air supplied to the furnace, whether it be under pressure or not, causes either a waste of fuel or of material through inability to maintain proper heating conditions in the chamber.

It is the design and operation of the furnace, and not the oil-burner, which is responsible for the ultimate result. No type of burner or method of preparing or delivering fuel to a furnace will remedy improper furnace design. It is just as useless to expect results from a poorly designed or worn-out automobile through the attachment of a good carbureter as it is to expect results from attaching a good oil-burner to a furnace that is not in condition to heat material properly after the heat is generated. The design and operation of the overwhelming majority of fuel-fired furnaces is a sad commentary upon so-called modern efficiency methods. The average furnace is not provided with the essentials that are common to an ordinary stove or house heater, and the average furnace operator does not display anywhere near the degree of skill exercised by the cook with the stove in the kitchen.

No type of burner or method of preparing and delivering fuel will remedy improper furnace design.

The desire for 'fuel economy' often results in a process of saving at the spigot and wasting at the bung, because of a lack of appreciation of the difference between the cost of fuel and the cost of uniformly heated product. A prolific source of this illogical practice is the so-called oil-burner test conducted in an attempt to prove that one type of burner is 'more efficient' and will produce a given result with less fuel than another. An analogous case would be to take the carbureter from a good car and place it on a poor car with the expectation of producing a radical difference in the cost of transportation. With the automobile, fuel is but one factor in the cost of transportation, and with the furnace for the same reason it is but one factor in the cost of producing uniformly heated product. In either case it is the proper combination of all the factors involved that produces the result. Generally speaking, a difference in fuel consumption reflects a difference in the construction or operation of the furnace, which is illogically attributed to the burner, which performs no other function than that of injecting the supply of fuel and air, the proportions of which are under control of the operator and the effective use of which is mainly determined by the furnace design.

Good combustion is not necessarily an indication of fuel economy in the operation of a furnace. It may be possible to show good combustion through analysis of flue-gases and at the same time waste fuel in a poorly designed furnace through improper position and size of vents, discharge of gases at unnecessarily high temperatures, excessive radiation through light walls or bottom, lack of control of the gases leaving the furnace, or difficulty of properly applying the heat to the material in the chamber, regardless of how good the combustion may be. It is possible to show good combustion in a furnace lacking provision to control the supply of air by delivering sufficient fuel to balance the air actually supplied. A good flue-gas analysis from such operation is surely not an indication of fuel economy. It is possible to maintain relatively good combustion in a furnace that is well designed from the standpoint of utilizing the heat and yet poorly designed from the standpoint of applying that heat properly to useful work. This is equivalent to maintaining good combustion in a good engine, the power of which is not properly applied to the driving wheels of an automobile. Unless there is proper heating of material or good results in the form of transportation, fuel economy in furnaces or automobiles is of little value, and unless there is proper design and operation of the furnace or automobile, oil-burners or carbureters cannot in themselves produce the desired result. The burner, like the carbureter, is but one factor in the operation as a whole, and in the case of a furnace is but the means to the end of producing quality product at low cost.

There is no one 'system' of burning oil. Practically all the methods employed are substantially alike and are governed by the same principles, which are not changed by variation in mechanical detail. The basis of the operation is the delivery of oil at a uniform pressure, with proper provision to ensure oil free from water and foreign matter; absolute control of all the fuel and air enter-

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ing the furnace; regulation of the air in proportion to the fuel required; control of the gases within the furnace; the application of the heat generated to a design of furnace that will permit uniform distribution of heat not merely in the furnace when empty, but to the material in the furnace when it is loaded to normal working capacity.

The idea of considering oil-burners as the essential requirement should not be encouraged. The application of burners to existing furnaces without proper provision in the furnace brickwork to maintain the conditions necessary for heating product properly, is in the long run a waste of time. Oil or any other fuel should not be considered solely on a comparison of b.t.u. costs. Each fuel, like all others, has its limitations, and the field of its usefulness cannot be determined by consideration of the fuel alone without reference to the operation as a whole, because it is not the cost of fuel but the cost of finished product that is the criterion of industrial heating operations.

The cost of finished product, not the cost of fuel, is the criterion of industrial heating operations.

Policy and Shop Rules Adopted by the Shipyards and Commercial Shops of the Bay District

The following statement of policy and shop rules has been adopted by the California Metal Trades Association, copies being posted in the yards and shops operated by its members at the time of resuming operations:

Policy

We, the members of the California Metal Trades Association, hereby declare the following to be the fundamental principles to govern us hereafter in our industrial relations with each other, our employees and the public.

We recognize the right of the employees to organize, but will not permit coercive measures to compel membership in such organizations, nor to compel employers to deal therewith.

We are unalterably opposed to the principle of the union or non-union closed shop, as it is un-American and unfair.

While disavowing interference with the proper functions of labor organizations, we recognize no rules nor regulations restricting production, impairing efficiency, or otherwise interfering with the management of the business. No member shall be required to deal with men or groups of men not his employees, or not chosen by and from among them.

We are strenuously opposed to strikes, sympathetic strikes, lock-outs, blacklists, boycotts, and kindred evils. We will resist those selfish interests which through violence, coercion, or otherwise attempt to disrupt the relations or peace and unity existing between employer and employee.

Since we must take the final responsibility for the work produced by our employees we must have full discretion to designate the men—journeymen, specialists, apprentices, helpers, or laborers—we consider competent to perform our work, what machines, tools, and appliances shall be used, and under what conditions the work shall be performed. The question of competency of the men is to be determined solely by us.

Because it is unfair to the American boy to deny him the right to learn a trade, and in order to create mechanics in proportion to the development of industry, we will not recognize any restrictions in the employment of apprentices. It shall be the duty and obligation of all employers to instruct apprentices in all branches of the trade. The California Metal Trades Association shall actively co-operate with various technical schools in this district in an effort to raise the dignity and efficiency of the various trades.

An employee should receive at least wages sufficient to maintain him at a proper standard of living. An employee's earning capacity should not be restricted whether working by the day, by the piece work, or by the premium system, and should be commensurate with his skill, proficiency, and ability to produce.

It is the privilege of the employee to leave our employ when he sees fit and of the employer to discharge an employee when he sees fit.

The above principles being absolutely essential to the successful conduct of our business we cannot permit any interference therewith. In case of disagreement (concerning matters not covered by the foregoing declaration and not affecting the economic integrity of the industry) our members will meet such of their employees as are affected by such disagreement and adjust the difficulty on a fair and equitable basis.

Shop Rules

1—Hiring and Discharging

(*a*) It is strongly recommended and urged that members in hiring employees give preference to American citizens or those who will or have declared their intention to become such.

(*b*) The right to hire, discharge, or lay off employee, rests with the employer, and is to be handled in such manner and through such channels as the employer deems best.

(*c*) A man may be discharged for cause at any time, or laid off at quitting time. In case of breakdown or a condition beyond the employer's control, a man may be laid off temporarily without notice.

(*d*) Any man feeling that he has been unjustly discharged shall have the right of appeal to the Superin-

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tendent, or Representative designated by the Management.

2—Classification and Wages

(a) Schedule

Metal Trades

Acetylene-burners	$0.76
Acetylene welders	0.80
Angle and frame setters	0.80
Anglesmiths	0.80
Apprentices (I)	...
Back-handler	0.58
Bending-rollers	0.80
Blacksmiths	0.80
Boilermakers	0.80
Bolters	0.58
Boltmakers (bolt and rivet headers)	0.80
Brakemen, yard	0.66
Carpenters, ship	0.86
Casting-cleaners	0.58
Checkers, material	0.64
Chippers and calkers	0.80
Chippers and grinders (foundry)	0.58
Coppersmiths	0.86
Counters (piece-work)	0.68
Countersinkers	0.64
Cupola-tenders (melters)	0.80
Dockmen	0.68
Drillers, pneumatic	0.68
Electric welders	0.82
Electrical workers	0.80
Engineers, locomotive	0.72
Engineers, in power-house (steam and electric)	0.80
Erectors	0.58
Firemen	0.58
Firemen, locomotive	0.52
Flange-turners	0.86
Foundry carpenters	0.68
Heat, frost, and asbestos workers	0.80
Heaters in forge-shop	0.76
Heaters in angle-work	0.68
Heaters (rivet)	0.56
Helpers (II)	
Acetylene burners and welders	0.52
Anglesmiths'	0.58
Blacksmiths'	0.58
Boilermakers'	0.58
Boltmakers'	0.58
Carpenters'	0.58
Coppersmiths'	0.58
Drillers', pneumatic	0.52
Electrical workers'	0.58
Flange-turners	0.64
Machine (flange)	0.58
Machinists'	0.58
Millmen's	0.52
Molders'	0.58
Pipe-fitters'	0.58
Plate-hangers'	0.58
Plumbers'	0.58
Punch and shear	0.58
Sheet-metal workers'	0.58
Ship-fitters'	0.58
Steam-fitters'	0.58
Holders-on	0.64
Hook-tenders (cranemen and crane riggers)	0.62
Hook-tenders' leaders	0.72
Hose-men	0.70
Improvers (III)	
Acetylene burners	0.58, 0.64, 0.70
Chippers, calkers and riveters	0.64, 0.68, 0.74
Drillers, pneumatic	0.64
Joiners, ship	0.86
Jitney drivers (shipyard)	0.58
Laborers (IV)	0.52
Layers-out (V)	0.85
Loftsmen	0.90
Machinists	0.80
Mangle-rollers	0.66
Metal-polishers and buffers (finishers)	0.80
Molders	0.80
Oilers	0.62
Operators of aerial hoists, single and double-cable ways, hoisting-donkeys and winches, hoisting cranes and derricks, carrying capacity over 3 tons	0.80
Operators of non-hoisting donkeys and winches	0.70
Packers (shipyard)	0.80
Painters	0.74
Painters, bitumastic	0.86
Passer boys (rivet)	0.36
Patternmakers	0.94
Pipefitters	0.80
Planermen	0.64
Plate-hangers (regulators)	0.74
Plumbers	0.80
Press-men	0.80
Punch and shear men	0.68
Reamers	0.68
Riggers, ship	0.80
Riggers, yard	0.74
Riveters	0.80
Rivet-testers	0.86
Sawyers (power hacksaws)	0.58
Scarfers	0.68
Sheet-metal workers	0.86
Ship-fitters	0.80
Specialists (VI)	0.62
Stage-builders	0.66
Steam-fitters	0.80
Switchmen, locomotive	0.66
Tank-testers	0.86
Timekeepers	0.58
Water-tenders	0.62

Wooden Shipyards

Boat-builders	$0.86
Calkers	0.94
Ceilers and plankers (clamp-hangers)	0.68
Helpers (II)	
Calkers'	0.58
Ship-carpenters'	0.58
Millmen	0.86
Ship-carpenters (shipwrights)	0.86
Ship-joiners	0.86
Stage builders	0.66
Treenail-machine operators	0.62
Woodworking machine (small), operators	0.62

(I) Apprentices.

(*a*) Persons over 16 years of age, who have had a good common school education, and who will bind themselves to serve for four years, may be employed as apprentices.

(*b*) Graduates of approved technical schools may be employed as apprentices under the same conditions but may receive credit for one or two years on their apprenticeship, as their experience and training warrant.

(*c*) A certificate of apprenticeship shall be given on the completion of the full apprenticeship.

(*d*) It shall be compulsory upon the management to instruct apprentices in all branches of the trade, and the California Metal Trades Association shall actively cooperate with the various technical schools in the district in an effort to raise the dignity and efficiency of the various trades.

(II) Helpers.

(*a*) A helper is a person whose regular duty is to assist a mechanic in setting-up work, in the operation of a machine, or in erecting and assembling; or who carries on work with the use of tools under the direction of a mechanic.

(*b*) The number of helpers to be employed shall be determined by the shop management, as necessity may arise or local conditions require, for economical production.

(*c*) Helpers may be advanced to specialists or machine-operators, or to journeymen, as their experience and ability warrant and as vacancies occur.

(III) Improvers.

An improver is a person who is raised from laborer or helper to journeyman in those crafts where it is not necessary to serve any stated apprenticeship in order to learn the trade. The improvers' period shall be from 3 to 6 months, and they shall be paid on a graduated scale as they become proficient.

(IV) Laborers.

A laborer is a person who regularly performs work generally recognized as common labor in or around shops or yards, and who does not require mechanical skill in connection with his duties.

(V) Layers-out.

A layer-out is a person whose regular duty is confined either to the surface-plate in machine-shops or to laying-out work in boiler-shops.

(VI) Specialists.

(*a*) A specialist or machine-operator is a person not qualified as a journeyman, who is regularly assigned to the performance of a specified task in any of the recognized trades, or to the operation of one or more machine tools on work of a routine or repetitive nature.

(*b*) Inexperienced men may be hired to become specialists at a starting rate not to exceed that paid helpers, such rate to extend over a probationary period of three months, after which the established specialist rate will be paid. Men experienced as specialists may be hired at the specialist rate.

(*c*) Specialists may as their experience and ability warrant, and as vacancies occur, be advanced to the work and pay of journeymen.

(b) Condition of payment.

1. Employees shall be paid on some regular and definite day of each week to within one week of pay day.

2. Any employee laid off, discharged, or quitting of his own volition shall receive all wages due him within twenty-four hours of the termination of his employment.

3. Employees working on regularly appointed night-shifts shall be paid an additional 5% on their regular rate.

4. As the hourly rate is the basis of the day's pay, men

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will be paid for the actual number of hours worked when working less than a full day.

(c) Piece work.

1. Piece work or other systems in lieu of daily rate may be adopted wherever practical if it will result both in an increase in production for the benefit of the employer and an increase in compensation for the employee.

2. Uniform rates shall be adopted for similar work and conditions in different plants.

(d) Premium men.

1. A premium man is one who is paid above the minimum rate established for his craft depending on his ability to produce.

2. New men should be hired at the minimum rate of pay for their craft and should not receive any premium rates until they have at least worked one month in the shop.

3—Hours, Holidays, and Overtime.

(a) Hours.

1. The eight hours of employment constituting a day's work shall be within nine consecutive hours. The hours of commencement of work shall be between the hours of seven and nine o'clock A.M., except that second and third shifts may be worked when necessary, at the discretion of the management.

2. Four hours shall constitute a day's work on Saturday, except in yards or shops where conditions are such that eight hours may be worked alternate Saturdays to advantage.

(*b*) "Dirty Hour."

1. The "Dirty Hour" shall apply to all industries, in which the "Dirty Hour" now prevails, as follows:

2. On all repair work performed outside the shops of the employers, and on any ship that has made one complete trip, cargo-laden, under its own power, the "Dirty Hour" shall be paid to employees performing such work.

3. On all repair work performed outside the shops of the employers, and on any ship that has made one complete trip, cargo-laden, under its own power, where the work will be facilitated by sending the employees from the repair job to the shop, to fabricate material to be used on this work, such employees shall be paid the "Dirty Hour" for each day so employed.

4. The above shall be computed on the full day only, and not to be applied on overtime. On Sundays and holidays one "Dirty Hour" shall be allowed, as computed above.

(c) Holidays.

The following days will be observed as holidays: New Year's Day, Washington's Birthday, Memorial Day, July 4th, Labor Day, Admission Day, Thanksgiving Day, Christmas Day, General Election Days for Governor and for President only.

(d) Overtime.

All time worked over eight hours shall be paid for at the rate of time and one-half for the first four hours after regular quitting time. Double time will be paid for all time worked after four hours after regular quitting time and for Sundays and the holidays specified above. Double time for all overtime will be paid upon all work when so ordered by the Emergency Fleet Corporation, and for all overtime on ship repairs outside of shops.

4—First Aid.

All establishments employing normally five hundred employees or more shall provide a practical trained nurse or nurses during all working hours and for thirty minutes thereafter. All establishments employing less than five hundred employees shall have available at their plant a person capable of administering first aid treatments. All establishments shall provide first aid emergency outfits for the establishment, the same distributed, that they may be available within reasonable time, irrespective of place of injury.

5—Traveling Time.

Employees leaving vicinity where employed to work on jobs when it is necessary to remain over night shall receive first-class transportation, board and lodging at place of employment and to receive eight hours' pay for each day's travel. If an employee has worked all day and is required to travel that night he shall receive eight hours' pay. If sleeping accommodations are not provided when traveling, the overtime rate shall prevail. Employees when sent out of the city shall have all legitimate expenses paid; also time to be allowed when traveling to and from the job. Fare only to apply to travel between San Francisco, Oakland, Alameda, and Berkeley.

6—Boycott.

Members of this Association reserve the right at all times to buy or sell their material, either manufactured or otherwise, from or to any place they may elect, and will insist that there be no discrimination on the part of their employees by refusing to work on such material, parts, or products.

7—Limitations of Output, Restrictions and Jurisdictional Conflict.

Since many rules, regulations, and shop customs have been enforced upon employees by business agents, shop committeemen, and individual agitators resulting in constantly reduced efficiency and production, we will not tolerate rules that arbitrarily place any limts: 1—upon the amount of work that a man can honestly perform; 2—upon the machine or machines or the kind of work upon which men may work, nor rules which permit interference by individuals with men who can and are willing to produce.

We will not allow jurisdictional claims to enforce the use of men from several crafts on work that can easily and economically be performed by one man.

Foremen and assistant-foremen, as representatives of the management, are responsible for the efficient and economical performance of the work, therefore, all regular foremen and assistant-foremen must withdraw from their unions while acting in such capacity.

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Solid Carburizers*

By T. G. SELLECK

The term carburizers includes all substances used in the carbonizing process for the propagation of carburizing gases. Iron has such an affinity for carbon that, when it is brought to a carburizing temperature, it is not at all particular concerning the origin of the carbon monoxide it absorbs, and will as readily assimilate the gases from the vilest offal as it will those from the purest sugar. And so it happens that the necessities of our forefathers brought forth some strange mixtures to be used as carburizers, and the history of the carbonizing process gives a variety of 'underfoot' substances, used successfully as carburizers to caseharden, or, as it was once termed, to 'steelify' iron. In primitive times the only carburizer used was charred wood, and charred wood still holds first place as an efficient all-round carburizer. Bone, leather, sawdust, shells, corn-cobs, coal, coke, and various other things are used, and are mentioned in the hundreds of patents on file in Washington, covering carburizers and carburizing processes, but none of these has been able to crowd out the original, and wood-charcoal forms the carbon base of our best carburizers.

Any of the substances mentioned above, if placed in close contact with iron or steel in a tightly sealed carbonizing-box and heated to a carburizing temperature, will carburize the metal without the addition of any other element. This carburization is accomplished by the carbon monoxide generated by the carburizing material penetrating the metal and, also, by diffusion into the metal of the solid carbon in direct contact with the metal. The evolution of the gas from the carburizer is limited by the amount of oxygen contained in the carburizer, and, when the carburizer is composed of carbon only, the carburization is necessarily slow. To promote the evolution of the carbon monoxide necessary for practical operation of the process, chemical energizers are added to the carbon. These energizers produce carbon dioxide, which, of itself, is decarburizing (a fact which we should bear in mind), but in combination with the carbon of the carburizer, it produces a constant evolution of carbon monoxide. The energizers employed are mineral salts, alkali or alkaline-earth carbonates, etc., and their proper proportions and their proper and uniform combination with the carbon, determine largely the value and efficiency of the carburizer.

To promote the evolution of the carbon monoxide necessary for casehardening, chemical energizers, such as mineral salts or alkaline carbonates are added to the carbon.

While, as stated, the metal undoubtedly absorbs carbon from the carburizer through 'molecular migration' of the solid carbon in intimate contact with the surface of the metal, it is conceded by all authorities on the subject that the greater part of the carbon absorbed is 'carried' into the metal by the carbon-monoxide gas furnished by the carburizer. Therefore, the value of a carburizer must be judged by its ability to produce the carburizing gas, at carburizing temperatures, and maintain a constant flow of gas during the carburizing period.

In judging carburizers from their efficiency as gas-producers, we must consider, first, their ability to retain their gases until a carburizing temperature has been attained. All gas evolved below that temperature is lost carburizing energy, if it is a carburizing gas, and if it is carbon dioxide, the energizing gas, part of the potential force of the carburizer is lost. The introduction of volatile hydro-carbons (which generate gases at low temperatures) into carburizers in order to hasten action is, therefore, of questionable value.

All gas evolved below the carburizing temperature is wasted.

Second, the ability of the carburizer to maintain a specific flow of gas during the carburizing period must also be considered. The flow of gas should be constant and increase with rising temperature, rather than diminish. So far as investigation has proceeded, the perfect carburizer has not been developed, when judged from these standpoints.

Some solid carburizers have been, and are, used with exceptionally good results by using them as 'mixed carburizers'; that is, by introducing, as a 'renovator', carbon monoxide, or carbon dioxide, gas during the whole or a portion of the carburizing period. 'Mixed carburizers' require special equipment, and the use of ordinary box-methods cannot, of course, be followed.

From the practical point of view, carburizers should be of a specific standard quality, that is, they should be capable of producing a certain definite result, under specific conditions of temperature and time. To be more explicit, carburizers should be manufactured according to formulæ which, by test, have been proved to be capable of producing a carburized case of certain analysis. It would be possible then for the operator to order from the manufacturer the carburizer best adapted to his work. If a case with a maximum of carbon of 0.90% is desired it does not help the casehardener if the manufacturer ships him a carburizer that will give him a carbon content of 1.00% or more. The manufacturer should know just what his carburizers will do under certain conditions, and recommend them accordingly. It is possible that sometimes we may be able to buy such materials guaranteed to produce 0.80–0.90% carbon,

*Abstract from 'Journal' of American Steel Treaters' Society.

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0.90–1.00%, 1.00–1.10%, and so on, when used upon certain steels for certain definite periods of time. If the casehardener could do this he would find his problems much easier to solve.

While the gas-producing qualities of carburizers are of the greatest importance, we must not forget the other carbon-yielding function, whereby carbon enters the metal by molecular migration. While we discuss the theory of the dissolution of carbon in the iron, through the decomposition of carbon monoxide, we are very apt to forget the other theory of molecular migration, or belittle its importance.

The proof of the phenomenon of molecular migration is easily obtained by simple means. It is necessary only to place two bars of steel, of different carbon content, in close contact, in a gas-tight case, and subject them to a high temperature for a few hours, at the end of which time it will be found that the lower-carbon steel has absorbed carbon from the other just by merely being in contact with it. Carbon monoxide being absent, there can be no other explanation of the phenomenon than the migration of the carbon from one piece of steel to the other. If a low-carbon steel can rob a high-carbon steel of a part of its carbon simply by being with it under normal carburizing conditions, how much easier and simpler must be the process of absorption when the carbon, in a free state, lies in intimate contact with the surface of the metal. We do not know just to what extent molecular migration acts in the operation of the carburization of steel, but I believe that it is of much more importance than is generally conceded by metallurgists.

As a basis for this belief, we know that coarse carburizing materials, which do not come into close contact with the surface of the metal, do not produce as high carbon content in the case, or as great penetration, under the same conditions of time and temperature, as do those of finer material that pack close to the surface and leave no voids. The difference is so marked that, if the advantage were all credited to the migration theory, our conception of it would be completely changed; but there are other reasons why a material that packs closely to the metal gives better results than one that, because of its size or conformation, leaves voids between its granules and 'naked places' on the metal. The most important additional reason is that the voids between the granules, pellets, or grains, of the carburizer give the gases a chance to float away from the metal, while when the more compact material is used, the evolution of gas is constantly occurring over the whole surface of the metal, and the chances of the gas getting away without yielding itself to the process of carburization are reduced to a minimum.

This justifies the theory that a powdered carburizer is better than a granular one. If a powdered carburizer were practical from other viewpoints, it would surely be ideal, but there are other things to be considered that eliminate that form of material from practical and economical use. Its low heat conductivity delays penetration of heat through the pots and boxes, and increases the danger zones of low temperature in them. Then the loss in handling, the rapid deterioration, and the dusty nature (to which every operator objects) places powdered material outside the list of practical forms of carburizers. The granules of a carburizer should not be all of one size, nor should they be of a uniform shape since the maximum of close contact with the metal is not possible in either case. A mixture of coarse and fine irregularly shaped granules will serve better because the contact with the steel is better and heat-conductivity is greatly improved.

A mixture of coarse and fine irregularly shaped granules is better than one where the granules are uniform.

The pound price of carburizers has little to do with their real cost or their practical value. One carburizer may sell for $75 per ton, weigh 60 lb. per cubic foot, making the real cost per cubic foot $2.25, while another may weigh 20 lb. per cubic foot and sell for $100 per ton, making the cost $1 per cubic foot. It requires the same number of cubic feet of either carburizer to fill a given number of pots containing equal amounts of steel parts, consequently, if the lighter material will accomplish the same results as the heavier, it is much cheaper. On a volumetric-value basis the heavier material would have to sell for less than half the price stated to equal the lighter in value. Volume per unit of weight is not a deciding factor in the choosing of a carburizer, however, unless its efficiency has been established along other lines by tests that leave no doubt of its merit. The real value of a carburizer depends upon the amount of work it will do judged by standards established by the operator. Without some standard of quality to which to work it is difficult to arrive at the real value of materials used in the operation, and casehardeners that have no set standard of efficiency by which to judge carburizers, might as well buy one as the other. But where quality of work is required, the efficiency of a carburizer should be established thoroughly before being adopted for general use.

Carburizers should never be selected on the price per ton basis.

Laboratory tests are of great help in determining the value of carburizers, but it is seldom that tests can be made in the laboratory on a scale comparable with production demands, or under conditions that exist in the furnace-room, so that such tests cannot always be taken as a deciding factor. The laboratory may, however, be able to decide whether the operator is justified in making the practical tests, by first determining the values, some of which have been mentioned, that a carburizer should possess, and must, of course, determine the final efficiency shown by the carburizer in the practical tests. It is the function of the laboratory also to establish the standards of efficiency whereby the carburizer is to be judged, but the deciding tests should be those of actual production under normal working conditions.

Laboratory tests of carburizers should be supplemented by actual service tests in the shop.

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In testing carburizers by practical shop-operations various methods are employed. Some casehardeners depend upon the results obtained by placing a single box, or pot packed with the material to be tested, in the furnace along with a number of others filled with the material used regularly. Such tests are of small value, as an indication of the real efficiency of a carburizer, unless they are repeated often enough to determine its stability—its ability to repeat its results. A carburizer, upon its first use, generally produces results above the quality it will maintain when used successively in a series of tests. Fresh carburizers invariably show heavy shrinkages, which are not noticeable in re-use, when just enough fresh material is added to maintain the original volume. The amount of fresh material, necessary to maintain the efficiency and the original volume, of a carburizer largely determines its cost.

A practical method of making efficiency tests of carburizers, where a laboratory is not available, and a certain scleroscope hardness is required, is the 'grinding test'. In making the tests, bars of a standard steel of the following dimensions are generally used: $\frac{3}{4}$ by $1\frac{1}{4}$ by 5 in. These bars are carburized for four hours at a temperature of 1650°F. They are allowed to cool in the carburizer, then heated to 1550°F., quenched in water, heated to 1450°F. and quenched in oil or water. They are carefully polished, care being taken to avoid 'drawing' the surface, and the scleroscope hardness of the surface is taken and recorded. The surface of the metal is then ground to a depth of 0.001 in., using an emery-wheel water-cooled, and the scleroscope hardness again taken and recorded. This operation is repeated until a depth is reached equal to that desired in the case.

Where microscopic examination is not possible this is a practical method of testing the hardness, and, indirectly, the carbon content, of the case, and its graduation from the surface toward the core. Metallography furnishes a more rapid and a more accurate method of determining these qualities, but it is not always available.

When comparative tests have been made along these lines it is found that some carburizers maintain the initial hardness to a depth of 0.08 to 0.010 inch, while others begin to show a loss of hardness at 0.004 to 0.006 in. After carburizers have been given these preliminary tests for efficiency, tests for economy are in line. These should be made on the basis of the carburizer's ability to maintain the standard of hardness in regular shop production.

The method of making such tests followed by the superintendent of a large Michigan plant, is not only practical, but is fair to the carburizing manufacturer. A record was made of tests of three carburizers. A certain number of pots were used in each heat, always packed with a certain number of steel parts of the same kind, and the cost of the carburizer was calculated in terms of expense per heat, all heats being of the same duration and at identical temperatures. For instance, to quote the record:

Carburizer No.	Number of heats run	Weight of carburizer used	Average weight used in heat	Cost per pound	Cost per heat
1...	157	1496 lb.	9.57 lb.	$0.045	$0.431
2...	98	1903 lb.	19.4 lb.	0.055	1.067
3...	126	2000 lb.	15.8 lb.	0.06	0.952

It will be seen from this record that the point mentioned previously, that the lighter material may be just as efficient as the heavier, is borne out in these tests. It happens that the lighter material, in this case, was purchased at a lower price than the heavier, but analysis of the record will show that, on the basis of results obtained, No. 1, the lightest of the three, could be used just as economically as No. 2 if it cost $221, instead of $90 per ton. No. 2 would have to sell at $35 per ton to compete with No. 1.

A report of this kind should also give the proportions of fresh material added to maintain the efficiency and the original volume used for each carburizer.

Iron Industry of South Africa

Although iron ore has been known to exist in South Africa for a long time and several small iron-smelting furnaces using scrap-iron have been in operation for a number of years, it was not until July 15, 1918, that the first blast-furnace for producing pig-iron from the ore was lighted. This furnace is situated at Pretoria, Transvaal. It has a capacity of 10 to 15 tons of pig-iron per day. Later in the year a similar furnace was started at Vereeniging, Transvaal.

All of the raw materials employed in the production of pig-iron are available from domestic sources. Unlimited supplies of iron ore have been reported by a Government geologist to exist in the Transvaal. While a great part of this ore contains a large proportion of titanium, and is consequently refractory and unsuitable for reduction in a blast-furnace, these difficulties are not entirely insuperable. However, it is not necessary to utilize the titaniferous ores for the present, as large lodes of excellent ore are found 3 to 50 miles north and west of Pretoria and in other parts of the Transvaal. There are two kinds of ore upon which the furnaces mentioned draw for their supply. One is a ferriferous quartzite or silica impregnated with iron, and the other is known as clay band or shale impregnated with iron. Good ores have also been found to exist in the neighborhood of Maritzburg, and in the Prieska and Kuruman districts.

Several furnaces utilizing scrap-iron have been in operation in the Transvaal for a number of years. This is obtained principally from the railways and mines. Small quantities of cast-iron scrap and imported pig-iron have also been used. A variety of products are made, mainly light sections, from half-inch rod to 30-pound rails; but steel castings are made as well, and have been produced up to five tons in weight. One mill has an annual capacity of 1000 tons. The metal varies according to requirements from mild-steel bars for blacksmith work to hard-steel bars used for tube-mill liners, but it consists chiefly of medium-carbon steel.

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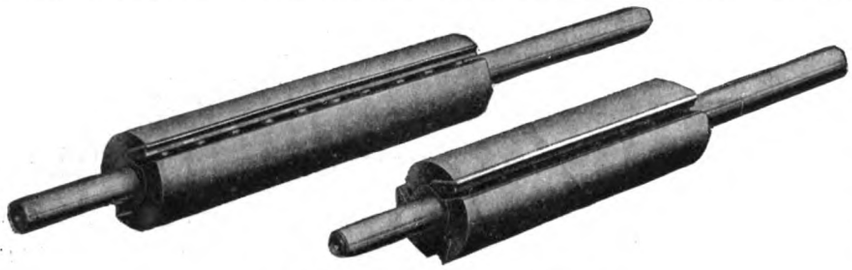
The Necessity for Using Cylindrical Cutter-Heads and Guards on Jointers*

By J. J. ROSEDALE

Order 603 of the Woodworking Safety Orders issued by the Industrial Accident Commission requires:

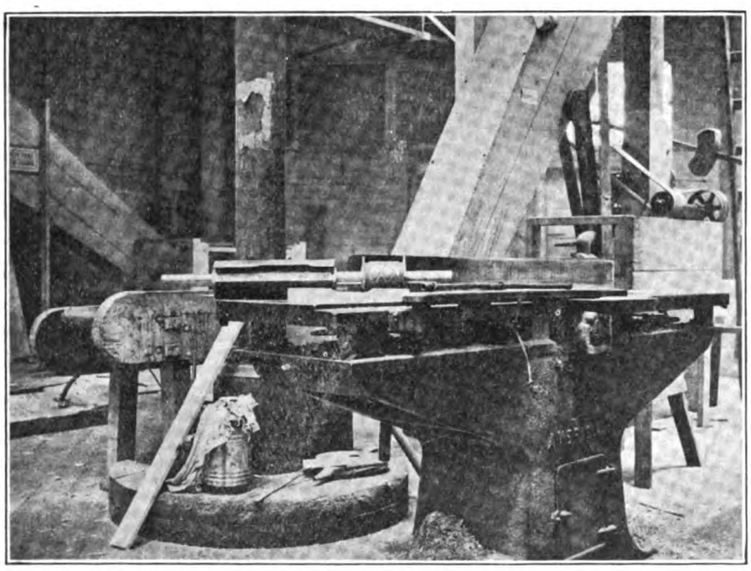
(a) All wood-jointers must be equipped with cylindrical cutter-heads of the safety type.

(b) A suitable automatically adjusted guard must be placed over the whole cutting-space in the table.



SAFETY CIRCULAR JOINTER-HEADS

While these Orders have been effective since August, 1916, I have found on my various tours of inspection that many of those operating jointers do not act in harmony with the safety requirements of the Commission. I have found numerous jointers in woodworking shops operated without guards. The owners, when questioned as to why the jointers were running without guards, answered that guards had been provided but had been cast away under a lumber pile, in a corner of the shop, or hung up beside the machines. The workers were asked why they did not use the guards, and answered that such guards were in the way and interfered with their work. It was pointed out to the workmen that it is a misdemeanor to remove a safeguard from a machine, and an employee meeting with an accident after removing the guard would be liable to a penalty of a 50% decrease in compensation.



JOINTER EQUIPPED WITH ROUND-HEAD CUTTER

About a year ago, while inspecting a packing-house, I met a pattern-maker, who was a foreman in one of the plants. This man had lost the ring and middle fingers on both hands on a square-head jointer in his own shop. The accident was caused by his slipping on the floor while operating the jointer. He lost his balance and fell, striking his hands on the cutting-space of the jointer-table. I asked him why he did not use a round-head cutter and his answer was, "If I had used a round-head cutter on my machine and met with the same accident, I would not have had any fingers left, for the speed of the round-head cutter is considerably greater than that of the square head." This statement is incorrect, for the speed of a jointer with a round-head cutter is the same as that of a square-head. A round-head cutter has never been known to cause more than slight cuts of fingers.

Another instance recently encountered was that of a former lumberjack, who is running a small planing-mill in San Francisco. He had a dangerous shop and possessed an old-style jointer with a suare head. Among the safety requirements called to his attention was the equipping of the jointer with a round head and a guard over the cutting-space in the table. He complained bitterly about this requirement and swore that he had used the square head for 35 years and had found it safe and efficient. On my second visit I was surprised at the different attitude on the part of the owner. He pointed to his little finger on the right hand, which had a slight cut, and related the following story: "I was very much against the idea of a round cutter and safeguard on my jointer when you first came to inspect my place, but law is law, and a week after your visit I fixed my machine with a round-head cutter. One day my right hand slipped on this machine and my little finger was cut and jammed very badly. If the square head had been on the machine, all my fingers would have been gone."

*Abstract from 'California Safety News'.

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Molybdenum and Molybdenum Steel

By W. E. SIMPSON

According to textbooks, the principal use of molybdenum is in the manufacture of tool-steel, but current reports as to its behavior in that capacity are so much at variance with each other that some difficulty may be experienced in forming a reliable opinion as to the exact state of affairs. Claims are made that the influence of the metal upon steel is similar to and several times more active than that of tungsten, but writers declare that its high price prevents it from becoming a serious competitor to the other steel-alloys in general use.

It is quite true that during the War, when cost was of minor importance, molybdenum did enter largely into the composition of various tool-steels, but diligent inquiry leads to the belief that its use for that purpose was confined to such times as the supply of tungsten fell short of requirements, and, if one may judge from information available, considerable doubt can be entertained as to whether at any time the resulting product really proved an unqualified commercial success. The highly volatile nature of the metal, as is well known, would naturally cause a change in chemical composition at each re-heating, and, consequently, an ever increasing alteration in physical structure must eventually result in the creation of a most unsatisfactory condition of affairs. The loss by volatilization involved in converting the mineral molybdenite into the alloy ferro-molybdenum is stated to be 15% of the metallic content. This gives a rough idea of the extent of change in composition likely to happen during exposure to a high temperature. At any rate no records are available of these tools having been in general use for any great length of time and we must assume that the chief utility of molybdenum must lie in some other way than in the manufacture of tools.

Investigators of fifteen or twenty years ago were unanimous in their outspoken condemnation of the metal under any conditions as a steel-alloy, and, so far as early day experiment went, the outlook for its commercial application was decidedly discouraging. A recent repetition of these investigations, however, has shown that the undesirable qualities imparted to the steel have been due, not to the molybdenum, but to the impurities with which ferro-molybdenum was then invariably associated; in fact, the real influence of molybdenum in steel-alloys is only now just beginning to be understood and future developments are likely to be of far-reaching industrial importance.

In the early stages of the War, reports were most consistent that the great German howitzers, which battered down the supposedly impregnable forts of Liège and Namur, and which were captured when on their way for similar work near Paris, owed their quality of endurance to the presence of a lining of molybdenum-steel. The American government, in order to test the value of these rumors, I am informed, caused chemical analyses to be made of the linings of two four-inch pieces of German field-artillery, and were unable to detect the presence of molybdenum in even the smallest traces. This is quite likely, and yet both reports may be perfectly correct. Lack of co-ordination of information in these and similar matters tends to give the impression that everything relating to molybdenum is surrounded with uncertainty from the exploration for the mineral to the marketing of the final product. Hence a situation has been created which to those interested is decidedly exasperating, while it is without adequate reason.

During the War a feeling existed among steel metallurgists of the Allied governments that the Germans possessed information regarding certain merits of molybdenum that could be turned to military advantage. Certainly statistics have shown that, in the three years preceding the War, the whole output of Queensland (Australia), then the world's greatest producer, went to Germany. The British government, therefore, as a matter of military necessity, bought every pound of molybdenite at sight, in order, not so much to use it themselves, but rather to prevent it from reaching the Germans. As a result, the price rose in Norway, on account of its geographic position, to over six dollars per pound.

Metallurgical research in England, during the War, showed that molybdenum, when added to certain steels, imparted not so much a hardening but rather a toughening property, which permitted the manufacture of plates possessed of great strength with comparatively little weight. The British War Department was not slow to realize that in this steel they had an ideal material for the construction of the famous 'tanks', and for that purpose it was used extensively, if not exclusively. It is always difficult to obtain information of a military nature but I believe that the steel plates of which the 'tanks' were manufactured contained, besides nickel and chrome, slightly in excess of one-half of 1% of molybdenum. The alloy was so tough as to be unaffected even when subjected to machine-gun fire at ten yards point-blank range.

No test could have been more severe than that to which the 'tanks' in France were subjected, and no better testimonial could be desired as to the super-excellent quality of the materials of which they were constructed than the record of their performances under the most trying ordeal imaginable. Many causes are attributed to the winning of the world war, but undoubtedly the work of the 'tanks' was a highly important contributing factor and the real secret of their efficiency was the part played by molybdenum in their construction. In the United

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States, credible report has it that molybdenum-steel was used for making the crank shafts of the Liberty motor, as well as for other parts of aeroplane construction.

Apart from war uses, the discovery of the toughening properties of molybdenum has led to its commercial application in several industrial directions where increased strength without excessive weight are important factors. Noteworthy instances of useful application, so far as the mining industry is concerned, include such articles as cam-shafts, cams, pitmen, and all parts of mining machinery where heavy duty is demanded. The applications for patents bearing on this matter are, I believe, so numerous as to give the impression that molybdenite mining is in for a 'boom'. One specific case is that of J. W. Weitzenhorn, who was granted a patent on December 10, 1918, for an invention which "relates to alloys for structural articles made of steel" in which "elements in proportion to their weight are required to possess great strength and toughness to resist stresses of various characters". He calls attention to the fact that with the usual steel-alloys from which articles are manufactured, if high ultimate strength and high elastic limits are desired, the effect of the necessary heat-treatment is to cause them to become hard and brittle. On the other hand, if toughness is required, then that quality is commonly "attained at a very substantial sacrifice of strength". According to the claim of the patentee, a most desirable combination of toughness and strength is secured with a steel alloy containing "about 0.35% carbon, 1% chromium, 0.15% vanadium, and from about 0.75% to 1% molybdenum".

It is common knowledge that the crank-shafts and many other parts of aeroplanes are made of molybdenum-steel but its greatest use in the immediate future seems to be in the manufacture of steel for auto-trucks, tractors, and automobiles. In this connection much credit is due to the industrial research-work of Child Harold Wills, so long associated with Henry Ford. He has been granted patents under dates of September 3 and of December 17, 1918, for certain steel-alloys in which molybdenum is the all-important factor. In his specifications Mr. Wills states that, "It has been impossible to obtain the super-excellent qualities of certain special steels without losing other properties absolutely essential to a commercial steel." He classes the various well-known alloys of steel for their defects and disadvantages: vanadium for "its liability to crystallization above certain narrow temperature ranges"; nickel "although having non-crystallizing characteristics superior to those of vanadium steel, is very hard to machine after heat-treatment"; manganese-steels while possessing "super excellent properties, such, for example, as exceedingly high tensile strength and high elastic limit—are unworkable and most difficult, if not impossible to machine"; and chrome falls short in some respects "particularly as to crystallization and narrow range of heat-treatment".

Thousands of test automobiles have now been manufactured of molybdenum-steel and given the severest commercial usage with eminently satisfactory results. Accurate statistics have been taken of miles negotiated per gallon of gasoline, tire-life, oil-consumption, etc., and the particulars, I believe, are cause for much enthusiasm. The year 1920, according to current reports, should see the introduction to the public of the molybdenum-steel car, the superiority of which, it seems, has now been thoroughly demonstrated beyond chance of dispute.

As regards details of automobile construction, I am credibly informed that an axle of molybdenum-steel has been twisted cold six times completely without showing signs of fracture. I do not know how far apart from each other were the twisting vises, as that would have some influence on the value of the test; for if these were close to each other, the pressure of the jaws would naturally tend to prevent any signs of fracture from showing, but, in any case, in this matter, confirmation is given to the assertion that the presence of a small quantity of molybdenum in steel undoubtedly does furnish a degree of uniform toughness that is truly remarkable.

Apart from use in the manufacture of aeroplanes and automobiles for which a steady demand can be confidently predicted, it seems to me that the scope of molybdenum-steel will be extended in degree to all other steel-consuming industries, although I am not prepared to endorse the opinion of some optimists who look to it replacing, to some extent, the other well established steel-alloys, such as nickel. Even if further metallurgical research were to hold out the hope of such a possibility, its realization is unlikely, if for no other reason than that an adequate supply is not available. "The future of molybdenum," said a British steel expert to me a few weeks ago, "depends on two factors, namely, assurance of supply and price."

As to supply, no molybdenite property at present known can offer, say, 50 tons per month, whereas the nickel-bearing orebodies are so large that during the War no difficulty was experienced in extracting from one shaft alone a total of 5000 tons of ore in one day. As a competitor of, say, nickel, I do not think that molybdenum has any possibility whatever but, as a valuable auxiliary, I believe that it will fill a most important position. Its action intensifies the excellent qualities of other important steel-alloys and eliminates the imperfection with which their presence is generally associated. Special steels in the composition of which nickel, chromium, or vanadium plays an important part, are handicapped with an extremely narrow range of temperature in heat-treatment beyond which their high-grade qualities are seriously impaired. The percentage of loss from this cause is high, consequently these steels are expensive. Molybdenum is the corrective. Its range of temperature in heat-treatment is great. Its function is to prevent segregation and crystallization, to promote uniformity of texture and secure a degree of toughness in steel that is always more or less lacking in the alloys of more common use. It thus exhibits the quality of the high-grade nickel or vanadium steel at a cost only slightly in excess of that of the ordinary article.

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Employment Departments That Have Promoted Goodwill

Scientific study of employment problems has not progressed as far on the Pacific Coast as it has in some other parts of the country, yet there are a number of companies, including several in the metal trades and allied industries, that have found that the establishment of employment departments promotes good feeling and efficiency, and has decreased labor turnover. Among these may be mentioned the Union Construction Co., the Standard Gas Engine Co., and the Shell Oil Company.

In April 1918, the Union Construction Co., of San Francisco, undertook a contract to build ten standard 8800-ton steel vessels for the U. S. Shipping Board. At that time the company had no equipment for this work other than its organization and good name gained in the construction of dredges and similar machinery. The entire plant was built 'from the ground up', with all the attendant advantages and disadvantages. One of the most important of the latter was the difficulty of building up a labor organization at that time, when labor, especially shipyard labor, was particularly scarce, and the competition for it was particularly keen.

Recognizing this fact, the management established a service department in charge of J. F. Johnston, assisted by C. L. Foster as employment manager. All men were hired through the employment department upon requisition, so that foremen and superintendents were not expected or required to spend their valuable time interviewing applicants for employment or hunting for men to fill vacancies. Inasmuch as many of the foremen had come from some of the older shipyards, it was necessary to convince them that this system was an improvement on the old custom of letting the foreman go out to the gate and pick his own men. It is greatly to the credit of the foremen that they saw the point quickly and that they co-operated effectively with the employment department. The team-work between the 'Yard' and the employment department was so good that a force of nearly 5000 men was recruited within a few months, and it was possible to start construction of the ships before the plant itself was completed.

As soon as the Armistice was signed, the demand for speed of construction at all costs was relaxed. It was then possible for the employment department, with the co-operation of the 'Yard' to exercise greater discrimination in the selection of workers, so that the efficiency of the working force was improved.

In addition to securing workers and assigning them to their proper place in the plant, the service department has had to deal with many other problems connected with labor administration as well as attending to other miscellaneous related duties. Arrangements have gradually been developed, based on the fundamental principle of giving a man a square deal, so that the small annoyances and grievances that are inevitable where a large number of men are employed can be settled properly without interference with production, and without causing discontent or hard feelings among the employees. The results have been so satisfactory that the service department is now firmly established as a profitable and necessary feature of the organization.

After the recent strike, the Union Construction Co. was particularly successful in building up an adequate well-balanced working force, and in attracting a large proportion of its old employees. It is noticeable that the workers have a more friendly feeling toward the company than is the general rule among shipyard employees. This in itself is proof of the value of the work of the service department, and illustrates the importance of placing the handling of personnel problems in industry upon a scientific basis.

The Standard Gas Engine Co. has been manufacturing gas-engines at its plant in East Oakland for several years. The plant includes foundry, machine-shop, and assembling department, and the normal working force is between 300 and 400 men. The employment department is in charge of G. J. Brusher. All hiring is done through the department on requisition from the factory, and all applications for transfer, promotion, or change of rate go to Mr. Brusher for approval and are then referred to the plant manager. Three principal methods of recruiting labor are used. First, through recommendation by present employees of their friends. Such men are particularly satisfactory, since an employee is not going to want his friends to come to work unless he himself is satisfied with working conditions, and also because an employee who is a good workman and likes his job is not likely to recommend a poor workman for employment. Second, through the State Employment Office. The officials in charge there do their best to send out satisfactory men, and, in particular, to send out men qualified for the particular work. If a pattern-maker is wanted, a pattern-maker is sent out, not, say, a drill-press specialist. Experience with other employment offices has not been so good. Third, some applicants are, of course, hired at the gate, but these form a relatively small part of the total force.

Some of the company activities, which, it must be remembered, have been undertaken, not as a charity, but because it is good business, and the men have it coming to them, include the construction of excellent lavatories in all parts of the plant and the establishment of a cafeteria large enough to serve the entire working force at one sitting. Lunches will be served at cost. The company's holding of land is large enough to provide for a good-

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sized athletic field, and the management co-operates with the men in supporting athletic activities.

Once a week, shop-meetings are held in the noon hour, ten minutes on the men's time and ten minutes, or more if need be, on the company's. Questions of working conditions and grievances are discussed freely at these meetings, as well as suggestions from the 'suggestion-box'. Sometimes outside speakers address the meetings. At the present time, plans are under consideration looking toward a scheme of representation that will give the employees some voice in the control of working conditions and other factory matters.

It is of interest to note that labor turnover, which was

STANDARD GAS ENGINE CO.— EMPLOYEE'S RECORD

Serial No. .....

Character of work ..... Clock No. .....

Name	Date we employed	
Address	Wages or salary at start	
Telephone	Increased	to
Married or single	"	"
If under 21, give Father's name and address	"	"
Nationality	"	"
Remarks	"	"
Record of last employment	"	"
Address	"	"
Date employed	Date of leaving	
Wages or salary	Reason for leaving	
Date of leaving		
Reasons for leaving		

RECORD OF WORK

Movement	Erecting	Sub-assembly	Mach. Shop	Pattern Shop	Iron Foundry	Office	Miscellaneous
Started							
Proficiency							
Transferred							
Quit							
Discharged							
Discipline							
Absent							
Period							
Late							
Time							
Overtime							
Time							

REMARKS: .....

FRONT AND BACK OF EMPLOYEE'S RECORD CARD

about 17% per month when the employment department was established, had been reduced to about 6% during the months immediately preceding the strike.

The Shell Oil Co. of California established a service and employment department at its refinery at Martinez during the summer of 1918, under the management of M. C. Burr. Although a refinery is not a metal-working plant, yet a number of men in the metal-working crafts are employed, and about three-fourths of the employees are skilled mechanics, so that the general methods that have tended to increase efficiency and good feeling and to reduce labor turnover at this plant would be likely to have similar success in the metal trades. Space does not permit a complete description of the Shell company's employment system, but one feature deserves particular attention, namely, the practice of 'advertising' jobs.

As is essential in any plant where a real employment department has been established, all hiring is done through the department, foremen and heads of other departments making requisitions on a regular form for men when needed. They are requested to turn these in as early as possible, and it is assumed that all requirements for additional men can be foreseen at least 48 hours. Any emergency that cannot be made to conform to this rule can be handled by overtime, or by temporary transfer from other branches of the work. When a requisition for men is received by the employment department, a description of the job or jobs is made out, giving the department under which the work is, the rate, hours, general character of work, qualifications required, and whether temporary or permanent, and this is posted on four bulletin-boards, one at each of the two gates to the refinery grounds, and the other two at places where a large number of men pass. Every man on the payroll has an opportunity to apply for any of the positions advertised, and of demonstrating, either from the records on file, or from additional information he can produce, that he can do the work. Furthermore, this advance posting gives an opportunity to the men to notify their friends of jobs open. Applications from new men are given the same consideration as those from men already on the payroll, but the policy of the employment department is not to give a job to an outsider if there is reason to believe that a man at present employed by the company in a lower position can do the work satisfactorily. The department holds that the employment of an outsider without giving the men on the job a chance, just because the said outsider happens to be a friend of the foreman, is just as indefensible as would be the action of a purchasing agent in buying supplies from his friends to fill a requisition, when an ample supply of the same articles was already on hand in the company's warehouse ready for use.

It is difficult to over-estimate the influence that this policy has had in increasing good feeling among the employees. The men feel that they have the first chance at any promotion, and that the company is not only willing, but anxious to give them as good jobs as can be made available. An important feature of the procedure is that as soon as a decision is made, the unsuccessful applicants are notified, and are saved further uncertainty. The notification includes a frank statement of the reasons for selecting the successful applicant in preference to the man notified.

A YOUNG MAN, not any too well fixed, approached a crusty old millionaire and asked for the hand of his daughter in marriage.

The old man started to splutter and get up steam for a double-barrel plutocratic kick when he was interrupted:

"Wait a minute, sir. Your daughter and I have made a wager on this. She bets you'll give your consent and I've bet that you won't. Now you wouldn't want your daughter to lose the bet would you?"

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Welding v. Riveting in Ship Construction

By LETSON BALLIET*

Progress in the use of welding instead of riveting in ship construction has been necessarily slow, being held back by the natural conservatism of those in charge of the work. Probably the first important use of welding in this work was as a substitute for calking, where some defect in the riveting caused a leak to develop at a seam. Welding was found to be less expensive and more satisfactory than either calking or cutting out and re-riveting.

The next application of welding was in filling rivet-holes punched in the wrong place because of some mistake. Here the only alternative to welding was the discarding of the entire plate, which might mean a loss of several hundred dollars. To make matters worse, an error of this kind is frequently not discovered until the plate is in position and partly riveted.

Another important application of welding is attaching to the deck the stanchions that carry the deck-rail. This saves punching holes in the foot of the stanchion, drilling and reaming the holes in the deck, packing the joint, calking, and testing. The deck-rail, which is a galvanized-iron rod running through the stanchions all around the boat, used to be joined by having the ends butted together in a sleeve made from a piece of pipe. Holes were drilled through the sleeve and through the end of each rod, and pins inserted. The stanchion-balls were also drilled and the rails pinned at each ball. The rail-ends were welded together and the rail spot-welded where it entered the stanchion-ball.

That this method is entirely satisfactory was demonstrated in an unexpected way when an accident happened on one ship that broke the rail down and tore it loose without one of the stanchions breaking in the weld.

It is my opinion that sufficient practical application of welding in shipbuilding has now been made to justify welding all the deck-plates, making the deck one smooth continuous water-tight plate. This would include welding the hatch-bounding bars, mast, king-post, stack, and ventilator-collars to the deck. After this has been done successfully it will be in order to try welding the shell-seams above the load-line, from which it is but a short step to the completely welded ship. I am not prepared to say that it will be advisable to eliminate all riveting in ship construction, neither am I prepared to say that this cannot be done.

Sufficient practical application of welding has now been made to justify welding all the deck-plates of the ship.

At the present time, between the plate as it comes from the mill and the plate riveted in the ship's hull there are at least 45 distinct operations. Just how many of these could be eliminated if welding was substituted for riveting cannot be definitely stated, but there is no doubt that the number could be reduced. Such a reduction might alone be sufficient to reduce the High Cost of American Shipbuilding to a point where competition with foreign yards would be possible. Some punching would still have to be done in order to bolt the plates in place and draw them together upon the structural shapes for welding. These holes would afterward be either riveted or filled by welding.

Some idea of the possible saving in cost in welding seams as compared with riveting may be obtained from the following: Assume a 6-ft. seam in plate $\frac{3}{8}$ in. thick. Riveting will require 96 holes to be laid out, centre-punch marked, and punched. Of these holes, 48 must be countersunk. The plate must be bolted, pinned, and the holes reamed. This requires 15 bolts with washers, and 48 rivets will be needed, besides those lost, burned, and wasted. Other operations not required when welding is used include building a staging for the holder-on, scarfing one piece of the plate, and calking the seam. A strip of extra metal $\frac{3}{8}$ by 8 in. by 6 ft. weighing 62 lb., is required for the lap, which at $0.04 per pound, costs $2.48. A gang of four men is required for the work, and there is considerable expense for fuel, compressed air, and rivets.

On the other hand, a welder can work at the rate of 3 ft. per hour, using $1\frac{1}{2}$ to 2 lb. of metal, at a total cost of $1.65 per hour. In other words, the total cost of welding the seam is but little more than the value of the metal saved because of no lap being required. Furthermore, the riveted joints at the best can develop not more than 65% to 70% of the strength of the plate itself, while the efficiency of a welded joint with good workmanship will range from 80% to 100%.

The total cost of welding an ordinary seam is but little more than the value of metal saved because of no lap being required.

Another reason for preferring welding is the oxidation or scaling of rivets. Rivets are made and cooled in the air and are then re-heated in a forge under forced draft with an excess of air, and then cooled in the air again. With the class of labor available for heating and handling rivets, 100% tight rivets are impossible.

Repairs where welding has been used originally are considerably easier than repairs by riveting. A particular common accident is the bending or breaking of rail-stanchions from collisions with hawsers or with heavy pieces of cargo during loading or unloading. Riveted stanchions have to be cut out, perhaps the rivets burnt out, in which case the fire goes

Repairs where welding has been used originally are considerably easier than repairs by riveting.

*Consulting engineer, Hobart Bdg., San Francisco, formerly efficiency engineer for Moore Shipbuilding Company.

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through the deck. With refrigerating boats this requires the lining to be removed and later replaced. With tank-steamers, the danger from fire is an added disadvantage. A welded stanchion can be cut above the deck and a new one welded in place without even requiring a man to go below decks. The cost is less than 5% of that of replacing a riveted stanchion. It is often possible to make repairs at sea or in any foreign port, at a considerable saving over repairs by riveting. Apparatus for both gas and electric welding can be carried on board. The latter can be run from the ship's electric-lighting system.

What Constitutes Real Service?

By H. R. DRULLARD

[The following article is taken, with a few minor changes, from "Keepintouch', the house organ of the Denver Rock Drill Co. While written especially concerning mining machinery, the principles set forth are applicable to any kind of equipment from baby-carriages to locomotive-cranes. Mr. Drullard is connected with the Butte office of the company.—EDITOR.]

To Credit Account, one Model 60 *Rifle Nut, defective, returned,* $10.

The mine superintendent is seen at his desk holding a credit slip in his hand, a pleased expression on his face, smoking—he is content.

There had been some question regarding a rifle-nut that had been worn out by three weeks' service. The part was returned to the Butte office, and as there was but one Dreadnaught at the property and that but three weeks in use, there could be no doubt about the period of service.

"Surely", contended Mr. Superintendent, "a rifle-nut properly made would last more than three weeks, otherwise no one could afford to change from the low-maintenance-cost piston-drill to this new type of drill. Now, Mr. Salesman, in justice to us and to yourself, should you not make good on your statement that you will replace any defective material"?

"Certainly", replied the salesman, "we want to be eminently fair, a credit will be issued and a new part supplied."

* * * * * * * *

This all happened in Butte back in 1916. We were new in the drifting-drill game then, knew none too much about the Dreadnaught, but were thoroughly conversant with the company's attitude toward 'Service', and their established policy of fair dealing.

We wanted to be fair both to our company and our customer. We made the replacement and were not fair to either.

Not fair to our company, for we had unjustly permitted to enter into the records of our customer an admission that our product is not uniform; that we occasionally let defective material slip by.

Not fair to our customer, for, instead of doing him justice by the replacement, we did him an injustice by not determining the cause of the excessive wear, for the cause was not in the heat treatment, but in the methods used underground.

When a rifle-nut is worn out after very short service, it is obvious that a corresponding wear is registered on the other parts, expensive parts like the barrel and hammer. We replace the one part, and permit the customer, through lack of proper information, to continue with bad practices that cause both his loss and our own.

In the case cited, the second rifle-nut wore out in a short time, the flutes of the hammer wore and the machine dubbed along, doing its work in a half-hearted fashion, and the machine was rapidly deteriorating. Why?

Investigation showed that the drill was occasionally oiled by pouring car-oil in the air-hose. The column was placed 3½ ft. from the face instead of 2½ ft., as it should be. The drill-steel was indifferently sharpened by hand. The fault was in the application of the machine, not in the material or design.

When we bring out a new drill, there may be for a short time a weakness in a certain part, but that is soon corrected and need not be taken into consideration in this article.

It is our firm conviction that each and every machine, each and every part that comes to us from the factory is perfect, and on this tenet we stand. Our experience in Butte has proved this, and when a question of replacement arises, it is up to the customer to show that the material is at fault, not for us to show that it is right.

This is the crux of the situation.

If a part fails, because of bad practice, and a replacement is made, it will occur again. If the replacement is declined and the bad practice responsible is disclosed, this bad practice is discontinued, and there is no further occasion for replacements.

An educational campaign was, of course, necessary. Our customers now realize that our stand is the right one and appreciate that the suggestion of proper methods is far more valuable to them than a few replacements from time to time.

Automatic Non-Return Stop-Valves on Steam-Boilers*

By CLARK C. BRADFORD

A recent accident, in which a steam-pipe on a boiler blew out of a flanged joint, causing the death of one man and injury to another, indicates the desirability of automatic non-return stop-valves when two or more boilers are connected to a common header, and particularly so when high steam-pressure is carried. The common type of stop-valve requires manual operation either directly at the valve or by rope, rod, or chain, attached to the hand-wheel and extended to the boiler-room floor, while

*From 'California Safety News'.

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automatic valves, should certain emergencies arise that their installation is intended to cover, will operate without any outside assistance. The importance of non-return stop-valves is now universally recognized, and their use is recommended by the Boiler Safety Orders of this State. If a tube ruptures in one of the boilers of a battery, as frequently happens in water-tube boilers, or a fitting gives way, the ordinary stop-valve is inadequate, as considerable time elapses before the valve can be reached and closed. In some plants where there is little head-room over the boilers, as in the basements of some buildings, it might be impossible to reach and close the valve because of steam flowing out of the break. Where non-return valves are used, this contingency is not apt to arise, as the reduction of pressure in the damaged boiler will cause the valve to operate instantly and cut off the boiler from the remainder of the battery.

At a plant in one of the valley towns equipped with three water-tube boilers, about three dozen tubes blew out of one of the drums because of low water. As the steam pressure carried was 185 lb., it can easily be imagined what a volume of steam could have been discharged in the boiler-room, making it unsafe for the operator and causing possible damage to property. However, the automatic valve, with which all the boilers were equipped, operated promptly and enabled the plant to continue operation without serious interruption and with no personal injuries.

Another feature that should commend such valves is that in the cutting-in of a boiler to the main header with the steam-pressure in the boiler lower than the header-pressure, the valve will not open until boiler-pressure and header-pressure are the same. Many disastrous explosions and accidents of various kinds have been caused by too hasty action in opening the stop-valve when cutting boilers into the line. They are also of great protection to boiler-cleaners and to those who have to do with the repair and maintenance of boilers in that these valves cannot be opened by hand although they can be closed by hand. Therefore, if a boiler is out of service and is equipped with a non-return stop-valve, the steam from another boiler cannot find entrance to the inactive boiler. Frequently, men working in boilers have had steam turned on them by the opening of the stop-valves.

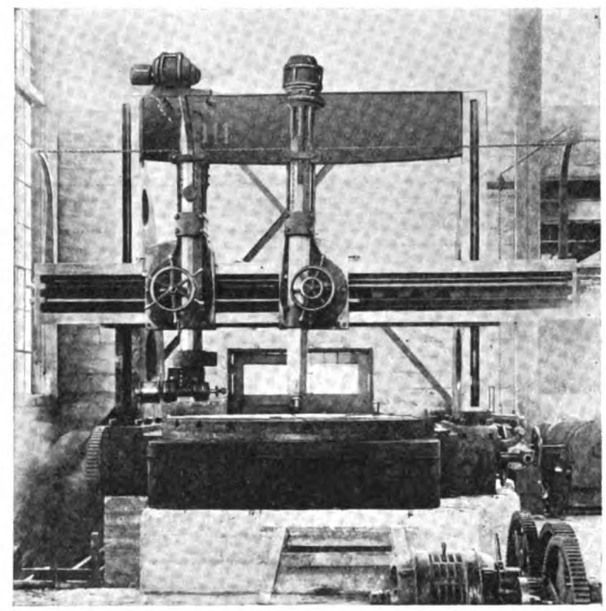
Needless Anxiety

There was a man
And all his life
He'd worked in a shipyard,
And he had a baby
And it was going to be christened
And for a week
He couldn't sleep nights
Because he was worried
For fear the minister
Would hurt the baby
When he hit it with the bottle.—

National Safety Bulletin.

Grinding Manganese-Steel

The fact that manganese-steel is so hard it cannot be machined but must be shaped entirely by grinding makes necessary the provision of special equipment for this purpose. The accompanying views are taken at the Oakland plant of the American Manganese Steel Co. The upper picture of the large group shows a grinding outfit working on a dredge-bucket lip. It is suspended from an I-beam by means of chain-blocks, which allows the operator considerable play in the manipulation of his wheel. The wheel is belt-connected to a 5-hp. motor, not shown. On the right is shown a similar but somewhat heavier outfit working on a bucket-pin. This is suspended by a



NILES BORING-MILL EQUIPPED FOR HORIZONTAL AND VERTICAL GRINDING. NOTE INDIVIDUAL MOTORS

column which is part of the frame, and a hook, also giving plenty of freedom of manipulation to the operator using the grinding-wheel.

For work that must be held rigid, several large machines have been equipped. At the left in the large group is shown a Gray planer with a grinding-wheel belt-connected to a separate motor. A similar arrangement is shown on the lathe in the lower picture. The single picture shows a Niles boring-mill equipped with wheels for both horizontal and vertical grinding, each driven by an individual motor.

In the upper part of the smaller group is shown a battery of four Ransom grinders all of them direct-connected to General Electric motors, ranging in size from 3 to 7.5 hp. As will be seen from the illustration, these are used mainly on relatively light pieces. Below is a semi-portable outfit mounted on a wheeled tripod. As the hose that is used for a conduit for the electric wires is several feet long, the tripod can be moved over a considerable space. Behind the tripod is a pile of track-links and parts for tractors.

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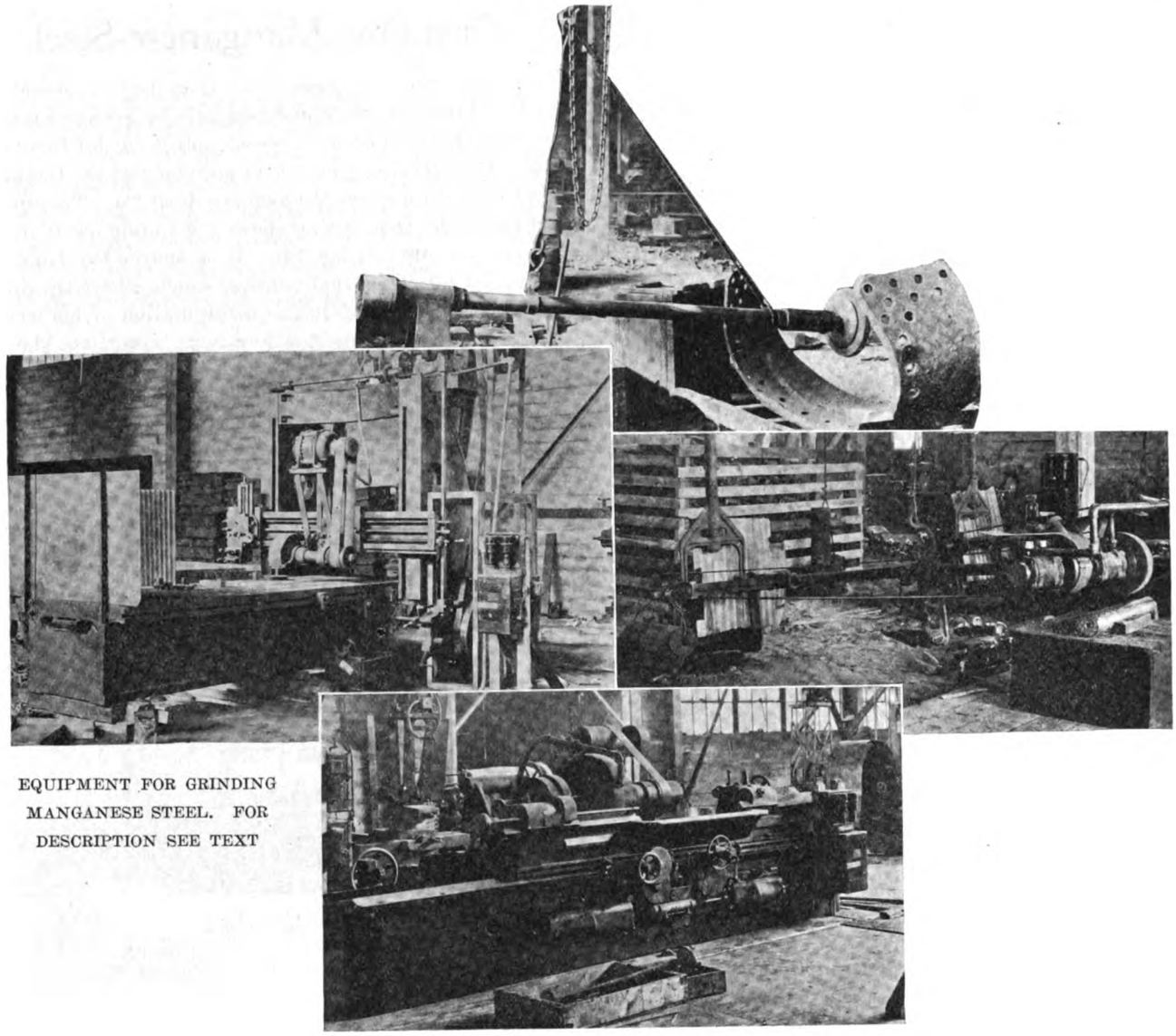
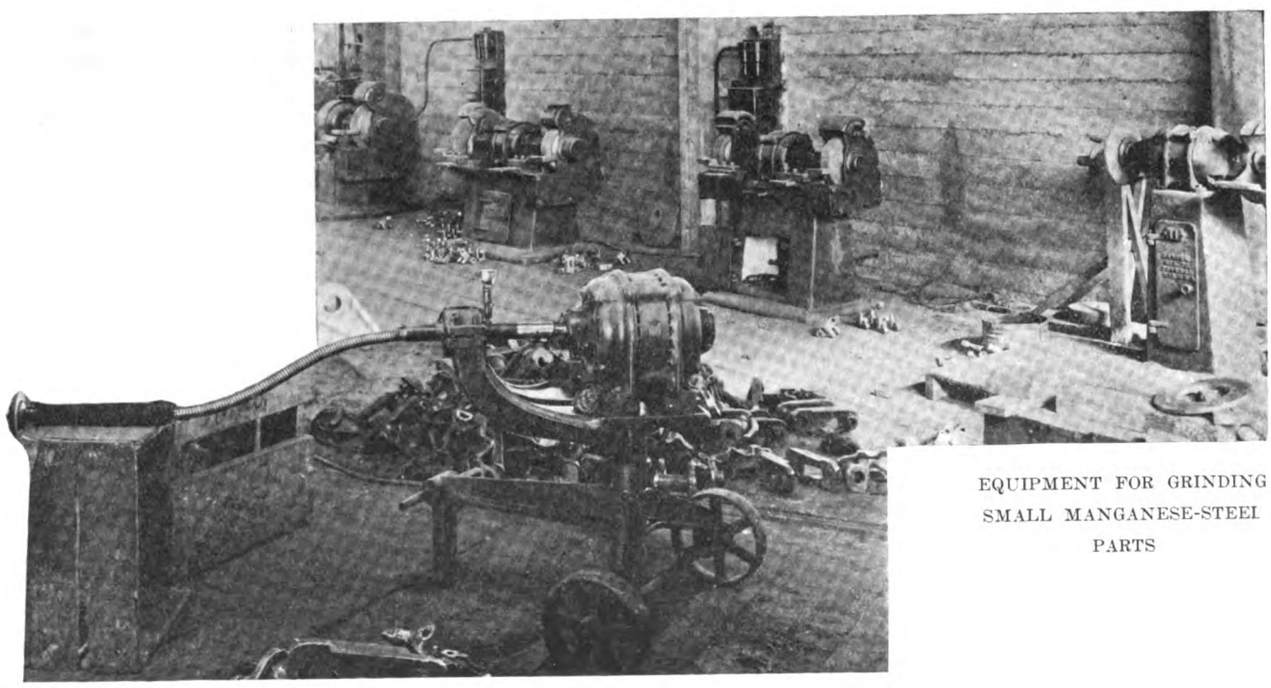


EQUIPMENT FOR GRINDING MANGANESE STEEL. FOR DESCRIPTION SEE TEXT



EQUIPMENT FOR GRINDING SMALL MANGANESE-STEEL PARTS

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Facing, not Running Away From Industrial Unrest

In another column appears in full the statement of the 'policy and shop rules' recently adopted by the California Metal Trades Association. This policy bears evidence of care and thought in its preparation, but without attempting to discuss the various principles set forth in detail, it is submitted that this policy does not, as in fact it could not, settle anything. It merely starts something. Perhaps it starts a great many things.

The 'policy' adopted by the California Metal Trades Association settles nothing. It merely starts something.

'Interference with the proper functions of labor organizations' is expressly disavowed, although the 'proper' and 'improper' functions of a labor organization are not directly defined. However, opposition is expressed in other parts of the statement to many of the functions now performed by labor organizations in the Bay district, so we may assume that these are 'improper'. It is self-evident that a union in an open-shop district, unable to compel employers to deal directly with its officials, unable to designate the grade or the kind of mechanic that shall perform a certain job, unable to limit apprenticeship, or to compel the reinstatement of discharged employees, is not going to be as powerful an organization as the metal-trades unions of the Bay district have been during the past few years. Means must therefore be provided for the protection of the interests of employees in dealings with employers that are either over-reaching or else simply indifferent to the rights of workers. Such employers are few, but they do exist, even in this district.

The many natural advantages that make for efficient production in this district are so well known that it is unnecessary to mention them here. However, high labor turnover and a discontented working force can be even greater hindrances to efficient production than the most obnoxious restrictions ever propounded by a labor union. In short, if the employer expects his employees to co-operate with him, he must not only be ready to co-operate with them, but must also give a great deal of attention to the best methods of such co-operation. The next few months will be the most critical period that we have seen in the industrial history of this district. The outlook is favorable for the establishment of a condition of industrial goodwill that will mean good wages and working conditions for the employee, a profitable business for the employer, and prosperity for the entire community. On the other hand, if the employer says to himself, "I have got rid of union domination. Now I can run my own business just as I ——— please," the industry will soon be in a worse condition than the one immediately preceding the strike. We must remember that the strongly organized unions have in the past acted as a check upon the actions of selfish or inconsiderate employers. With that check partly removed by the reduction in the power of the unions, there will be nothing to prevent the employer of small vision from wrecking the goodwill in the entire industry. Then we shall see industrial unrest far worse than any we now know, followed by the ascendancy of labor organizations of the most radical type. Self-preservation and the welfare of the entire community demand that employers give their best attention to the study of industrial relations.

If the employer expects his employees to co-operate with him, he must be ready to co-operate with them.

Many employers recognize the need of action to meet the present industrial unrest, but it is unfortunate that so frequently this recognition has shown itself mainly in a vague desire to do something and do it quickly. Indeed, the efforts made along these lines by many otherwise capable business executives bear a strange resemblance to the activities of a hen just after her head has been severed from her body. Shop committees, industrial democracy, profit sharing, and many other systems are grasped like straws by the drowning. Space does not warrant the discussion of the merits and demerits of the systems described by these names. Most of them have had their conspicuous successes; all have had their conspicuous failures. There is no more magic in a name in the field of industrial relations than in any other field. Long ago it was pointed out that "The letter killeth; the spirit giveth life". Any system for handling industrial relations that is based on common sense and on giving a man a square deal (and the two principles are both synonymous and complementary) is going to have a considerable measure of success. Any system not so based is sure to fail.

Any system based on common sense and on giving a man a square deal is going to have a considerable measure of success. Any system not so based is bound to fail.

To give a man a square deal means to give him what he has earned; no more, and no less. It does not mean 'welfare work', nor charity, nor unearned bonuses. It does mean making a man independent and observing the time-honored rules for industrial relations: "The laborer is worthy of his hire", and "Do unto others as you would have them do to you".

With these two maxims as a basis, the employer can build up his system for handling industrial relations, which does not necessarily have to be elaborate. However, in a plant of any considerable size, the owner or the chief executive has so much to occupy his attention in the general management of the enterprise, that it is as impracticable for him to give detailed personal attention to personnel

In a good-sized plant, the chief executive cannot give detailed personal attention to personnel problems.

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problems as it would be for him to scrutinize each minor item of a purchase order. Experience has shown that, generally speaking, any plant employing 500 or more workers needs to have a capable man to devote his entire time and attention to the relations between the company and its employees, and that any plant employing as many as 100 workers should have a man who gives these relations his principal attention. For convenience, this man is usually called an employment manager, or a service manager, or a service and employment manager. Where a distinction between the two terms is made, the employment manager handles simply the employment department, and reports to the service manager, whose field covers all the relations between the company and its employees. But it should be repeated that these names are simply used for convenience; there is no magic in the names themselves. Merely to give the title of 'Employment Manager' to the nephew of the chairman of of the board of directors and to give him an office, a stenographer, a Ford car, and a desk on which to put his feet, is not going to help to solve a factory's employment problems. It may even make them worse. Neither is the position of employment manager a pension-job to be given to some employee, who, because of either old age, injury, or other disablement, is unable to do anything else. Such a man is not likely to have the respect of either heads of departments or of employees.

What, then, are the essential qualifications for an employment manager? It is unfortunate that many people have conceived an employment manager to be 'an impractical sort of cuss' with several degrees after his name and very little else. In fact, in certain quarters the term carries with it as sinister a significance as 'efficiency engineer'. In reality, it takes a capable man to be a success as an employment manager, just as it does to be a successful efficiency engineer, and there are few of either.

It takes a capable man to be a success as employment manager.

First of all, he must have sufficient education and industrial experience so that his judgment will be respected and his conclusions well-founded. Second, he must have the tact, diplomacy, and persistent and practical inspiration that will enable him to put his ideas into practice. He should possess, not the enthusiasm of the amateur, but rather the steady enthusiasm of the man whose judgment controls his ideals. Third, he must have a certain knowledge of the general technique of this class of work, of 'hiring and firing', and of personnel work in general.

Given a man with these qualifications, with sufficient authority to do what he sees needs to be done and the money with which to do it, and the results will be satisfactory both from the standpoint of humanitarianism and of dollars and cents. It might seem unnecessary to emphasize the need of sufficient authority, but it is hard to persuade even some of the more progressive companies to treat the managers of their employment departments as anything more than glorified clerks. To get the best results, the employment or service manager should be responsible to the general manager only, and should have similar authority, responsibility, and salary to that given to the sales manager, the purchasing agent, or the production manager. If the employment manager does not deserve such prerogatives, he is not worth having at all.

The employment and service manager should have similar authority to that given to the other heads of departments.

Above all, let it be reiterated that it is the spirit of giving a man a square deal actuating not only the staff of the employment department, but the entire staff of the plant that counts. The War gave the worker a new sense of his importance in the scheme of production. This has warped the viewpoint of many workmen, and has been misused by the radical leaders for their own ends, but at the same time it has started the conservative majority to thinking along new lines. This is a fact that must be considered in handling industrial relations in the future. We cannot go back to pre-war manufacturing methods, neither can we go back to pre-war methods of handling industrial relations. And, in fact, we do not want to do so.

New Cutting-Gas Developed

The properties of a new cutting-gas, called calorene and developed from the manufacture of alcohol, were described by Alfred S. Kinsey, of the Stevens Institute of Technology, in a paper presented before the American Foundrymen's Association. It is an unsaturated gas containing 86% carbon and 14% hydrogen. As a cutting-gas it is practically the equal of acetylene. It gives a maximum temperature of 6200°F., while acetylene gives a maximum of 6300°F.

Under certain conditions, some cutting-gases leave the surface on each side of the kerf of a job covered with an oxide scale so hard that it is impossible to machine the surfaces, and even grinding is inefficient. The metal under the scale is also sometimes likely to become granulated and brittle because of the action of the flame. The kerf-scale when calorene is used is about 0.008 in. thick on a 4-in. cut, and is noticeably thin and fragile. The hardness of the under surface is undisturbed.

Calorene may be compressed to 3500 lb. per square inch and stored as a free gas, no filler being required in the cylinders. This is one of the reasons for the lightness of a commercial cylinder of the gas. A cylinder containing 210 cu. ft. of gas weighs only 85 lb. as against 250 lb. for acetylene. The new gas may be brought in contact with oil and grease without danger of explosion. It will work at low temperature and its point of combustion is about that of illuminating gas. It has a pleasant odor and its products of combustion are unnoticeable and harmless.

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Machining of Bearings

In a paper presented at a recent meeting of the American Society of Mechanical Engineers, C. H. Bierbaum, vice-president of the Lumen Bearing Co., of Buffalo, New York, called attention to some common errors in machining of bearings, saying, in part, as follows:

In the construction of journal-bearings one matter which is very frequently neglected, perhaps most often because it is not thoroughly understood, is that of driving in bushings. As all bearing-alloys have a temperature coefficient of expansion higher than that of cast-iron, and as the bearing is directly subject to the friction of the journal, it follows that the bearing is at a higher temperature than the cast-iron housing and that all bearings must have an appreciable outward expansion when in operation. For this reason bushings should be driven with just enough pressure to prevent looseness during operation.

Bushings should be driven with just enough presure to prevent looseness during operation.

The practice of driving bushings so tight that they require reaming before they can be put into service cannot be condemned too severely. The subsequent reaming does not remedy the evil, since a bushing driven so tight will and must continue to contract inwardly in operation, since the outside pressure upon it is not removed by the reaming. In the tooling of a bearing a definite amount of clearance should be provided, in order to ensure the best service conditions. When a bushing is driven too tight, even if it has been reamed before being placed in service, the amount of clearance it will then have becomes a matter of guesswork and the amount of oil-film space provided is uncertain. This condition frequently causes heating and bearing troubles, even though the amount of internal contraction may not be sufficient positively to grip or stop the journal. The idea that bushings must be driven tightly in order to hold them in place is fundamentally wrong, and excessive tightness of the bushing in its housing should be avoided. For all ordinary machinery it will suffice if a bushing may be driven in place with a blow of the hand or with a small block of wood. The provision of fastening the bushing in place should be such that it will not bind or clamp the latter against outward expansion.

The finishing of bearings in such a manner that they may expand while warming-up is of considerable importance. The two edges of the two half-bearings should be 'brass-bound', that is, they should bear solidly against each other and should exert a pressure against each other somewhat in excess of the maximum crank-pin load. The outer surfaces of both bearings near these edges should be relieved so as not to bear on the straps. The four corners of the bearings should be relieved in like manner so that the horizontal thrust will be mainly borne upon the surfaces falling within the area of the horizontal projection of the crank-pin. A bearing thus constructed expands with the first slight increase of temperature, relieving the crank-pin instead of clamping it as when these precautions are not taken.

Another matter very often overlooked is the manner in which bushings or bearings in general are clamped during tooling. With a $\frac{5}{8}$-in. 16-thread set-screw and the application of, say, a 50-lb. pull upon a 12-in. monkey-wrench, a pressure of 50,000 lb. can be carelessly exerted upon the bushing in question, and it must be remembered that the composition of a bearing material is never one that would be selected for maximum strength. A bushing tooled when clamped in this manner seldom has a bore that even approaches a true cylindrical surface, and if it is then driven upon an arbor and finished on the outside an inaccurate product is the result, one which can never give the most satisfactory service. The best and most satisfactory method of holding bushings for tooling is by clamping them endwise.

The most satisfactory method of holding bushings for tooling is by clamping them endwise.

Chamfering of oil-groove edges deserves special attention, since all advance edges of a bearing should be rounded and chamfered, and it is important that this work should be done last, after all the other tooling of the bearing has been completed. Upon any surface that is being tooled, two forces are being exerted, one horizontal or parallel to the finished surface and the other vertical or in a direction normal to that surface. The resultant of these two forces is a force tending to deflect the edge of the groove obliquely downward. It can readily be appreciated what an injurious effect is produced in a bearing if any tooling is done after the oil-grooves have been cut, especially if the direction of rotation of the journal is opposite to that of the tooling. In all cases, sharp edges of the groove prevent the formation of an adequate oil-film and should be carefully avoided.

No tooling should be done on a bearing after the oil-grooves have been cut.

For best results it is necessary and it is also general practice that a cutting tool should have rake. Consider now the standard multiple-cutting-edge reamer, which is often used in finishing bearings. A $2\frac{1}{2}$-in. reamer would have, say, 14 edges and the amount of bursting or internal pressure that it would exert within a bushing would be at least 14 times that exerted in case the bushing were reamed with only one improper tool. The final finishing of bearings should be done by reamers or cutting-heads having only one or else a limited number of cutting-edges, and these cutting edges should have the proper amount of rake, such as would be given to any proper cutting-tool. Experiments made in a large manu-

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facturing plant on bushings of the same dimensions, from the same lot of material, finished at the same time (some, however, being reamed with the standard multiple-cutting-edge reamer and others with a single cutting-blade) showed that after a storage of six months those bushings which had been reamed with a proper single cutting-edge retained their accuracy and shape much better than those finished with the standard reamer. The latter bushings exhibited a decided tendency to decrease in inside diameter and to assume inaccurate elliptical forms. It was also brought out at this time, that not only did a superior product result from the use of a proper tool, but that by its use the production could be increased from 15 to 20%.

Another reason why bearing surfaces should be tooled with sharp tools having the proper amount of rake is brought out by a microscopic study of bearing surfaces. In order to obtain the full value of bearing alloys it is necessary that these alloys should be presented as bearing surfaces having their natural crystallization undisturbed. The hard or bearing crystals should be embedded in a softer material, permitting the former to adapt themselves to the journal surface; the softer crystals under proper service conditions will wear slightly below the surface of the harder crystals. In order to retain these conditions it is necessary to preserve the natural crystallization upon the bearing surfaces, but this cannot obtain where they have been mutilated by improper tooling. This mutilation of the bearing surfaces gives rise to the crushing of the harder crystals and embeds these crushed particles into compressed material which does not function as a normal bearing-alloy.

The Associated Industries of Seattle

After the general strike of last February various commercial organizations of Seattle, impressed by the need of a closer alliance for defensive purposes against the radical forces that were trying to control the city, formed the Associated Industries of Seattle. Like San Francisco, Seattle has been for many years practically a 'closed-shop town', and there was considerable advocacy at that time of an immediate declaration for the open-shop. However, more conservative counsels prevailed, and it was decided that the sensible and loyal members of the unions should rather be aided in cleaning house and eliminating the radical leaders. The energies of the newly-formed organization were therefore directed toward the cultivation of better relations between employer, employee, and public.

Unfortunately, the 'better element' in the unions followed the example set by the 'better element' in so many other organizations, and made little or no effort to eliminate the radical domination. Early in the fall, events occurred convincing the members of the Associated Industries that there was no hope of the unions cleaning house. A series of strikes were called in various trades, the movement taking on such a form as to give grounds for the suspicion that the radical leaders were attempting to accomplish by piecemeal the same ends they had tried to obtain at one stroke in the general strike of February. Carpenters and some other unions in the building trades, job-printers, tailors, pile-drivers, and dyers and cleaners all struck, most of them making absurd demands and refusing arbitration.

On October 14, after six weeks of negotiations for a reasonable agreement with the unions, the Seattle contractors, backed by the Associated Industries, declared for the open shop, or the 'American Plan of Employment', as they prefer to call it. This is defined as assuring every man the right to work regardless of political, religious, or labor affiliations and that the employer shall be assured the right to hire employees without consulting union officials. On October 31, the Building Trades Council called the strike off and the men returned to work at the old wages and under open-shop conditions. Open-shop conditions have also been established in the other industries mentioned above where strikes had been called.

World's Current Shipbuilding

The following summaries, compiled by the Bureau of Navigation, Department of Commerce, from Lloyds Register returns show the number and gross tonnage of ships actually under construction on June 30, 1919, and on September 30, 1919, and indicate the relative current changes in shipbuilding. The total tonnage building is over double the corresponding tonnage at any pre-war period. Steel shipbuilding is increasing, wooden shipbuilding declining. French merchant shipbuilding is beginning to be normal, delayed only by lack of coal. Italian shipbuilding is benefiting by the output of the yards of Trieste. The table gives separately countries in which building exceeds 100,000 gross tons, and all others are lumped. No returns from Germany are available.

Under steel is included the small concrete tonnage building, comprising for September 30 in all yards 44 of 67,105 gross tons, of which 21 of 11,577 gross tons were in British yards. Composite ships are included with wooden.

Country	Steel gross tons	Wood gross tons	Total gross tons
June 30, 1919			
United States	3,174,542	699,601	3,874,143
United Kingdom	2,521,757	2,293	2,524,050
British Dominions	235,324	111,129	346,453
Japan	282,060	.....	282,060
Italy	243,940	27,680	271,620
Holland	219,332	.....	219,332
Spain	118,269	585	118,854
France	107,215	2,400	109,615
Others	241,500	30,140	271,640
Total	7,143,939	873,828	8,017,767
September 30, 1919			
United States	3,088,488	382,260	3,470,748
United Kingdom	2,802,903	13,870	2,816,773
British Dominions	238,649	69,816	308,465
Japan	209,600	.....	209,600
Holland	288,042	.....	288,042
Italy	261,328	24,600	285,928
France	169,452	5,284	174,736
Sweden	94,477	6,740	101,217
Others	283,393	19,680	303,073
Total	7,526,332	522,250	8,048,582

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Detecting Defects in Metals With the X-ray

In a paper presented recently before the American Iron and Steel Institute, W. E. Ruder discussed the application of the X-ray to the inspection of castings and forgings for defects. While in medical practice, the direct use of a flourescent screen is common, in examining metals this method is limited to about 0.01 to 0.02 in. thickness of metal. Obviously internal flaws in such thicknesses would be relatively unimportant. For the examination of a manufactured article, for the inspection of assembly, the screen has been successfully used. For most purposes, however, a photographic plate must be employed so that the cumulative effect of time may be utilized.

Radiographs are detail shadowgraphs, and, since the rays cannot be focused as in ordinary photography, the image will always be 'life-size' or larger. Moreover, the rays producing the shadows are not parallel but emanate from a point-source. For this reason, variations in intensity caused by differences in density in the object will be sharper when near the emergent side, and their sharpness will diminish and their size apparently increase as they are nearer to the incident side. This point-source distortion is diminished by increasing the distance of the tube from the object, at the same time, however, decreasing the intensity of the rays.

The protection of the operator from the action of both the direct and secondary rays is important. Owing to the high penetrating power of the rays used, protection is even more important in metal radiography than in radio therapeutics. Too great care cannot be taken to guard against these rays. Complete protection should always be provided.

With the best apparatus at present on the market, the metallurgist is limited to the use of a 10-in. (100,000 volt) spark-gap. This will require an exposure of about three hours at five milli-amperes to radiograph two inches of metal. This represents the present practical limits of the process. Of course, for purely research work, much higher voltages are available and have been used, making the practical radiography of greater thicknesses of steel a thing to be reasonably expected in the future.

Another difficulty met in radiographing greater thicknesses is that to be detected, any flaws must be proportionately larger as the piece is thicker, particularly if situated at any appreciable distance from the photographic plate. The scattering effect of the large mass between the flaw and the plate will, during the long exposure required, so fog the outlines of the image that it may not be visible, and even though a radiograph can be made, it will not with any degree of certainty show the presence of flaws really existing.

The examination of forgings presents greater difficulties than castings because the defects usually occur as hair-line cracks or lines which, unless they happen to run almost parallel to the path of the rays and in a straight line, would not be visible on the negative. Even under these favorable circumstances, differences in density because of these defects are difficult to detect, for the radiograph does not enlarge and shows only such defects as would be visible if exposed to the naked eye.

In order to determine the thickness of the smallest air-inclusion that can be distinguished radiographically, two plates of steel were machined and ground to flat surfaces. In one of these a slot was cut to give a wedge of air of varying thickness. Each plate when finished was $\frac{5}{8}$ in. thick. The two steel plates were then bolted together and radiographed at 15 in. gap. In this manner it was found that an air inclusion 0.021 in. could be detected in $1\frac{1}{4}$ in. of steel and an air inclusion of 0.007 in. could be detected in a total thickness of $\frac{5}{8}$ in. of steel. This is under the most favorable conditions, when it was known beforehand that the inclusion existed and just where it was.

To summarize: From the point of view of those who are interested in the metallurgical application of X-rays, the following conclusions may be drawn:

1. The practical application of metal radiography in the workshop, bearing in mind time of exposure and available apparatus, is at present limited to about $1\frac{1}{2}$ in. of steel.

2. For purely research purposes and with special apparatus, somewhat greater thicknesses are possible of examination, but the results are increasingly harder to obtain and more difficult of interpretation as the thickness increases.

3. Only such inclusions as would, if exposed, be visible to the naked eye can be detected; hence the detection of hair-line cracks or of small sonims is uncertain.

YEARS AGO Thomas A. Edison used to try to instill the rudiments of science into the head of his young son and never overlooked an opportunity to use some everyday happening to illustrate some principle of mechanics.

On this particular occasion, chancing to spy a peddler pushing a hand cart, the great inventor cried:

"Now there's a good example. I don't suppose you can tell me why he pushes the cart instead of pulls it. I don't know whether the man himself could answer. I'll ask him."

"My good man," said the inventor, turning to the peddler, "why do you push the cart rather than pull it?"

"Cause I ain'ta da hoss, you dammna fool," was the unscientific, though disconcerting answer.—Los Angeles Times.

In the opera 'Aida' one of the scenes is laid 'in front of the Temple of Isis'. At the close of the scene the curtain signal was given with a bell-buzzer which was heard all over the house. The operator of the curtain was evidently slow in answering, for the bell continued to ring and a woman in the audience said, "The telephone in the temple is ringing—why in the world doesn't the high priest go in and answer it?"

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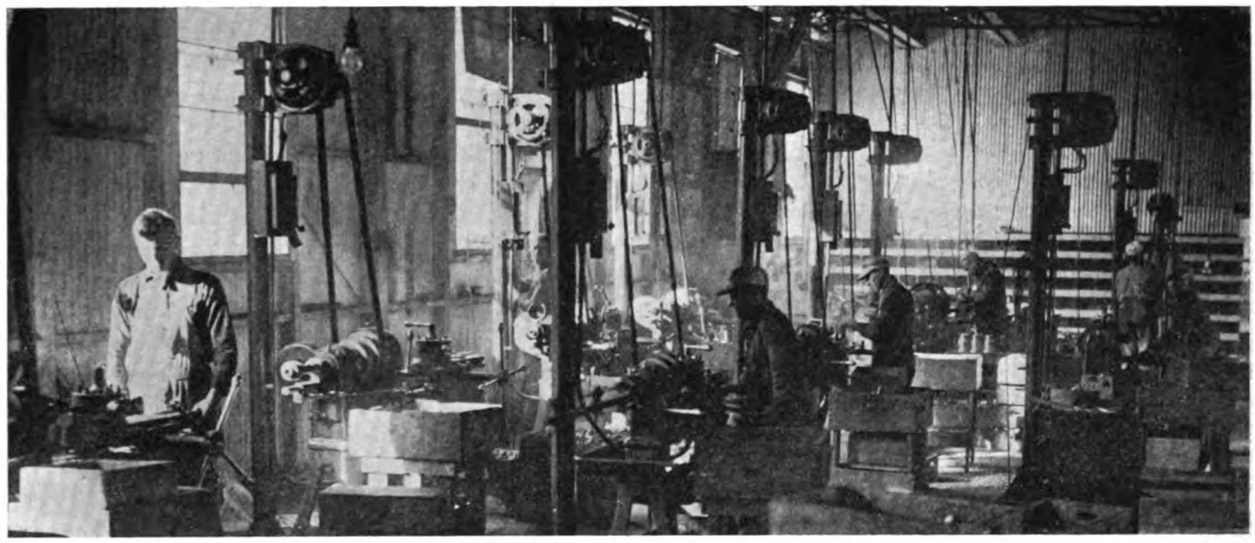

PART OF MACHINE-SHOP. NOTE INDIVIDUAL MOTOR-DRIVES

We Can Compete if Properly Equipped

By DOUGLASS W. CHURCHILL

The problem of competing with large Eastern firms has always confronted the manufacturers of the Coast. Here, where the sales field is limited, some method must be found to overcome the advantage of quantity production that is enjoyed by the Eastern men. One Californian brass-foundry making a large line of valves and bibs for the plumbing trade has met the difficulty and is today producing at a cost which permits it to meet the Eastern prices on the market. This firm, the Price-Corcoran-Pfister Co., of Los Angeles, is a strong factor in the Western sales field.

The ability to compete with the larger concerns lies both in the advantage of location and in the methods employed by the firm. The freight rate is in favor of the local concern, their overhead is lower and they are able to give better service and deliveries. But these things alone would not permit them to overcome the disadvantages of manufacturing for a smaller market. It was necessary to get manufacturing costs to a point low enough so that advantage could be taken of the other factors in favor of the firm. This meant modern manufacturing equipment and methods.

One of the special appliances manufactured by the firm for its own work is a brass-furnace. This has since been placed on the market. It was constructed with low cost of heating and quick and easy relining in view. Two sizes are made—a 400 and a 600-lb. The one used in the foundry melts 3500 lb. per day. Crude oil is the fuel, and five gallons is required to the heat. The flame enters one end of the cylinder and passes over the metal, never touching it. The furnace is easily dismantled for relining, and this operation is performed in three hours. The cylinder is relined about every two hundred heats at a small cost.

A great saving in labor is made in the foundry department by means of a fine equipment of multiple patterns. Skilled molders are not required on this class of work. Mexicans can be broken in to do the molding in a few days. The runners are on the pattern-plates and the molder is easily taught to draw his patterns with the help of a vibrator, to cut his gates and risers, and to set the cores.

Girls have proved to be satisfactory as core-makers. With the carefully designed metal core-boxes that are used, core-making is a simple operation, and does not require skilled labor.

Machine-shops the world over have experienced difficulty and have been subjected to large expenditures from the necessity of reversing machines and lathes quickly, using the countershaft method of drives. After a great deal of experimenting the Los Angeles firm finally adopted a system of individual motors. The engineers of the United States Electric Mfg. Co. worked with the foundry and produced a specially wound motor for intermittent service that has done away with the countershaft. The motor is controlled by a switch at the height of the waist-line of the operator, so that it is not necessary for him to reach to throw it in or out. As 4200 reversals of the lathe are required in eight hours work, this quick and easy method is important. The motors reverse the machines instantly.

The motor is mounted on a post, which is not connected with the lathe in any way. Thus vibration is prevented. Due to the winding armature, the motor is suc-

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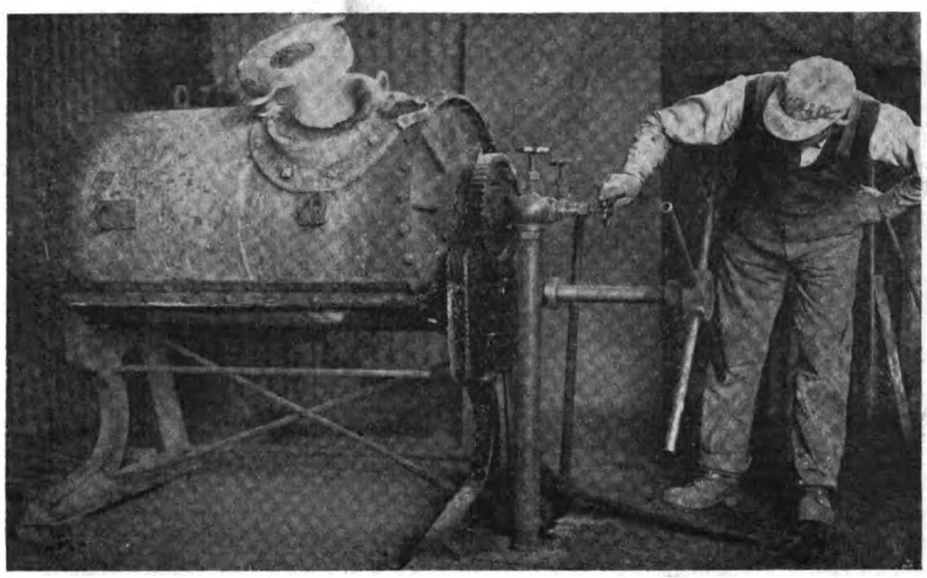
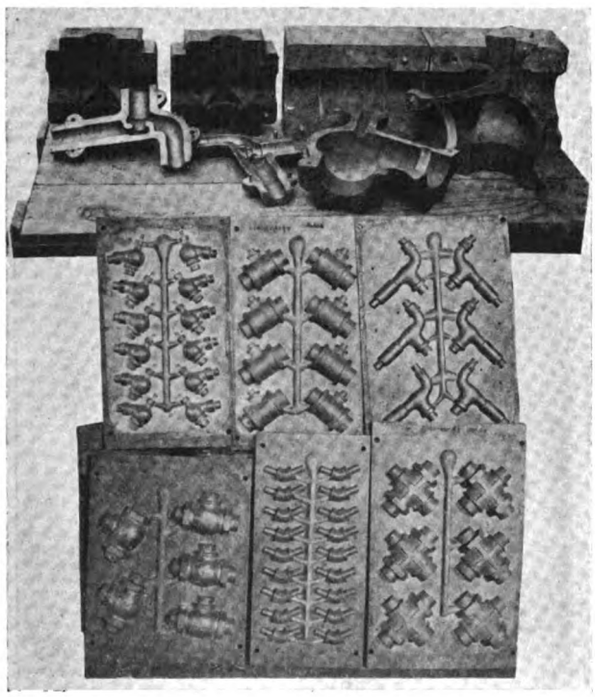


BRASS-FURNACE MANUFACTURED AND USED BY THE COMPANY

cessful when being constantly reversed. It would heat quickly if run in one direction for a lengthy period.

A splendid equipment of jigs and special tools are



ABOVE, SET OF CORE-BOXES. BELOW, GROUP OF MATCH-BOARD PATTERNS. READING FROM LEFT TO RIGHT THESE ARE: UPPER ROW, GARDEN-VALVES, REDUCING-TEES, COMPRESSION-BIBBS. LOWER ROW, STEAM GLOBE-VALVES, 45-DEGREE ELLS, AND SERVICE-COCKS.

used in the machining operations and have done much to increase production. Taking a ¾-in. garden-valve as an example, the tooling process is as follows:

Seven operations are performed at one chucking and in one instance, two threads of different pitch are tapped at the same time. The casting is placed in a specially constructed chuck. A box-tool machines the hose end and then the threads are turned with a releasing die. Without taking the casting from the chuck, it is revolved at right angles. The flat cutter is used to bore and face the holes in the stem and bottom ends, then two taps are run into the brass at the same time. The tap used to thread the stem-hole, being smaller and of a different pitch, is placed loosely in the centre of the bottom tap so that it slides lengthwise and is drawn in as the casting is rotated. The valve is again revolved at right angles and the box-tool and the releasing die are run on the packing-end in separate operations. Thus seven tools are run at one chucking in six operations. Compression bibs are made in the same way. A battery of 14 turret lathes and brass lathes manufactured by Warner & Swasey is used.

The cost of equipping the plant was greater than if ordinary methods had been pursued, but the increase in speed is so great and the lowered cost of production so decided that the firm is the gainer at the end of the month. Mr. Pfister estimates that at least 20% of the labor cost has been eliminated by the installation of the tools.

Each department is supervised by one of the owners. Mr. Price has the supervision of the tools and the patterns; Mr. Corcoran is in charge of the foundry, and Mr. Pfister oversees the machine-shop and inspection department.

The success of the company in manufacturing in such a highly competitive line while many other brass-shops have failed entirely in the manufacturing field, lies in the equipment of modern tools. An investment of many thousand dollars is represented by the match-board patterns, the turret-lathes, and the jigs, fixtures, and special tools. But the use of this modern equipment constitutes the difference between manufacturing and jobbing and is a pre-requisite to success. The 'can't compete' cry comes from those that have tried to manufacture with a job-shop equipment. This cannot be done economically, but manufacturing is both possible and profitable on the Pacific Coast in any line for which there is a market. The experience of the Price, Corcoran, Pfister Co. and many other firms proves this conclusively.

'Twill be a record Christmas;
One doesn't need to wheedle;
So to my friend I think I'll send
A brand-new fibre-needle!

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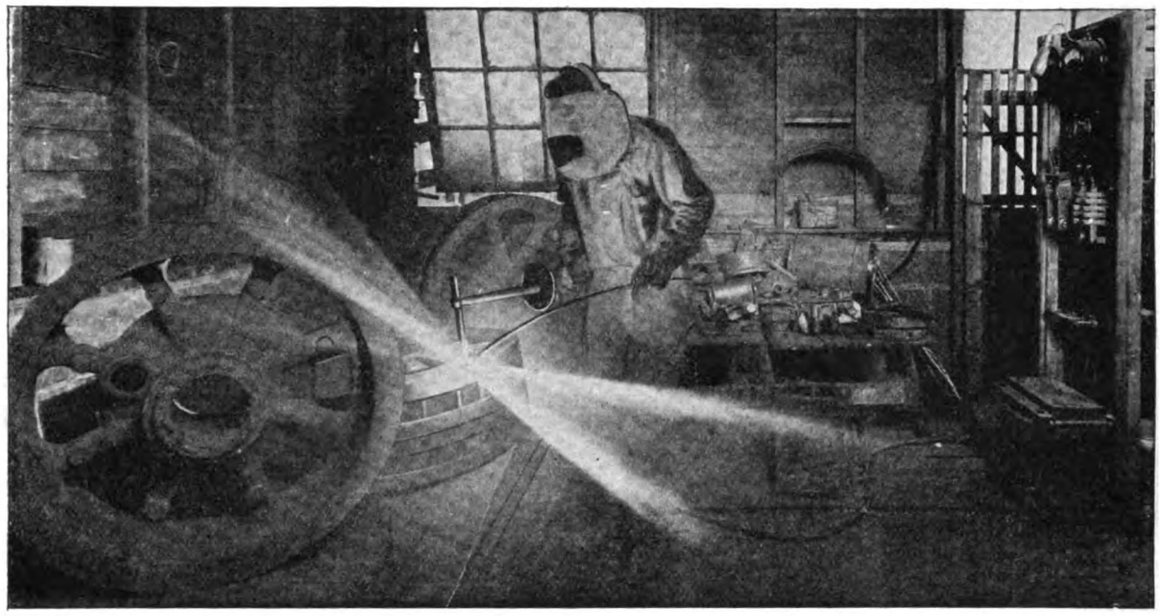

Filling Blow-Hole in a Cast-Steel Motor-Truck Wheel. These Castings, Though Subject to Severe Strain, Were Approved for Use in Military Motor-Trucks When the Defects Were Repaired with the Electric Arc.

Some Applications of Electric-Arc Welding*

The first important commercial use of arc welding was in repairing defects in steel castings. Blow-holes and shrinkage cracks large enough to have caused the rejection of a casting in the old days can now be repaired at small expense, and the metal can be deposited in such a manner that the repair is as sound as the rest of the casting. Another important advantage of the use of arc-welding is that the foundryman can make better deliveries. Formerly, there was a chance, even with the most careful molding and pouring, that a large proportion of the day's output might turn out to be spoiled castings. Now the foundryman knows in advance that, even if a few surface defects occur, most of these can be repaired with the arc. He can therefore promise early deliveries, and can keep his promises. Furthermore, the electric arc enables the foundryman to get along with less skilled labor. Formerly, it was useless to employ any but the most highly skilled molders on steel castings, since a less-skilled man was likely to spoil more castings than he was worth. Now most of such castings can be repaired at small expense.

In using the electric arc in the steel-foundry, the blow-holes, shrinkage-cracks, sand-holes, or other defects are first preheated by playing the arc over the surface, holding the casting in such a position that sand and foreign matter will be flushed out. This work is done with the carbon electrode. The filling material may be obtained from the steel wire made for the purpose, or even from steel scrap or bars of suitable analysis.

For foundries making small castings, a welder sup-

Filling a Blow-Hole in a Steel Casting by the Carbon-Electrode Process.

plying 200 amperes will usually be found sufficient. For the foundry making castings up to 1000 lb., a 300-ampere welder should be used. For large work, a 400-ampere machine is recommended, and this can be arranged so that two or more machines can be connected in parallel,

*Abstracted from 'Electric-Arc Welding', issued by the Lincoln Electric Co., Cleveland. Illustrations from the same source.

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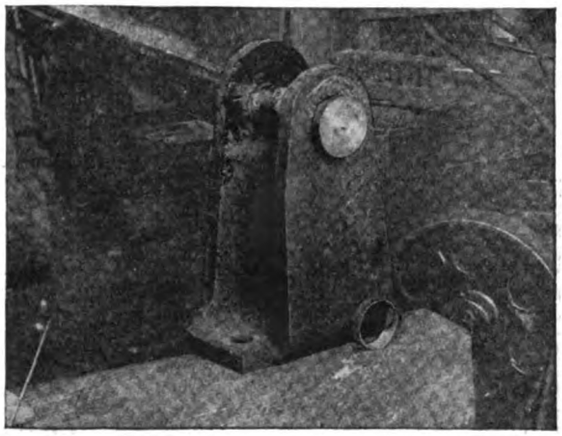
thus giving the current needed for heavy-carbon electrode cutting.

The railroad repair-shop is another field where electric welding has been found advantageous. The metal electrode is used almost exclusively, since the carbon process can be employed effectively only when the work can be placed on a table and when the casting can be annealed subsequently. The parts are first cleaned thoroughly and, where two pieces are to be joined, a V-shaped groove is chipped. The angle of the groove must be large eough to permit the operator to reach the bottom. For boiler-plates the angle is usually 90°, while on large steel castings, 45° to 60° is preferred. For most work the two



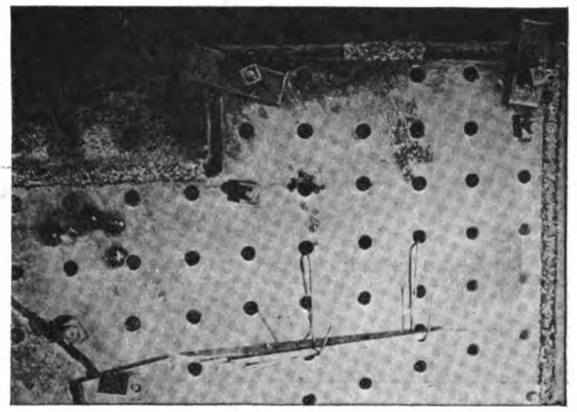
Brake-Fulcrum Repaired by Arc Welding. The Hole in this Fulcrum Was Badly Worn. By Placing a Copper Band or Ferrule of the Right Size in the Hole and Building Up Around It the Ferrule Could be Knocked Out After the Welding Was Completed, Leaving a Smooth Round Hole, Which Needed No Machining.

pieces must first be aligned and then clamped together or to a third piece. If metal of any height is to be built up with the carbon-arc process, a mold of fire-clay or carbon must be made to retain the molten material.

The following directions for welding cracks and patching seams are given by the Association of Railway Electrical Engineers:

"A crack should be located and at least two inches beyond each end a ½-in. hole drilled. The edges of the crack should then be beveled so that the operator can get at them to make the weld. On horizontal cracks, the lower edge does not need to be beveled but should be chipped to give a square edge. The upper edge should be beveled at least 45°. Vertical cracks should be beveled from 30° to 45° on each side. The less material removed from the cracks the better. All welds should be made with the least possible amount of metal between the edges of the original material.

"If the crack or seam is a long one, the metal should be put in alternate sections four to six inches long. The operator should put one layer of metal in each of these alternate sections, starting near the centre of the seam or crack. The open sections can then be filled, starting at the coolest point. Successive layers of metal can then be applied until the seam is completed. Wherever possible, at least 30% of reinforcing should be applied so that the cross-section through the weld is 30% greater than the section of the original plate. After each layer of metal is welded into the seam, it should be thoroughly brushed with a stiff wire brush to remove as much of the oxide as possible. Where the sand-blast is available and



Providing for Expansion in Side-Sheets by Making the Weld in the Alternate Sections

can be used on the job the results will justify the expenditure of time necessary to clean the metal between layers. The same general care should be taken in the welding of locomotive-frames as in the case of the boiler-plate of the fire-box."

"Where long seams are to be welded, as for example,

Welding a Hatch-Cover on a Steel Vessel

in welding-in a half side-sheet, practice again differs as to the best method of taking care of expansion. Some operators prefer to allow for expansion by widening the gap between the sheet, this being done by setting the new sheet away at a slight angle; the allowance usually made by these operators is about ⅛ in. to ¼ in. per foot of length. Then when the weld is begun at one end and the work is carried on, the two edges will gradually draw together, due to the contraction of the weld in cooling. Other operators prefer to place the two edges in final relation to each other, holding them at the proper distance apart by means of 'tacks' at intervals of 12 to 18 in. The weld is then begun at either end and, as it ap-

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proaches a 'tack', the tack itself is cut out by use of a chisel and solid metal welded in, the tack simply serving the purpose of holding the sheets in proper relation until the weld is made. When tacking is used, it has been found advisable to weld a short space, six or eight inches

Rotary Cement-Kiln Made of 1¼-in. Plate Welded by the Electric Arc. The Weld is Only Partly Completed and the V-shaped Joint Before Welding Can be Seen at the Right.

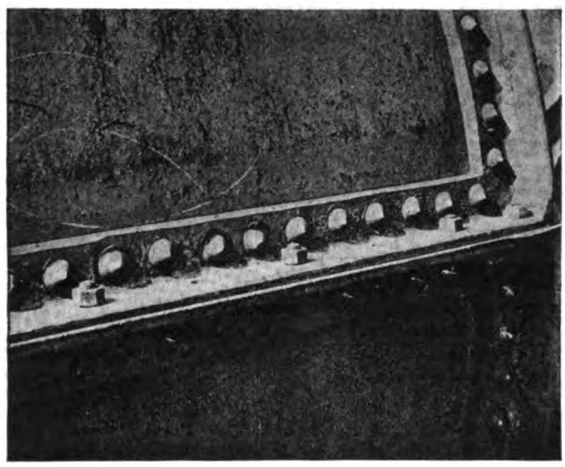
from one end of the seam, then go to the other end of the seam and weld a like distance, thus keeping heating and expansion at a minimum."

The applications of arc welding that have received the widest publicity have been in conection with shipbuilding and ship repairs.

The classification societies have so far considered and approved the application of electric welding to the following parts of vessels:

Deck-rail stanchions to plating.
Clips for detachable rail-stanchions.
Continuous-railing rods (joints).
Attaching deck-collars around ventilators.
Attaching deck collars, smoke-stack.
Attaching cape-rings, smoke-stack pipes, etc.
Attaching galley-fixtures to plating.
Attaching bath and other fixtures in officers' quarters.
Attaching cowl-supporting rings to ventilators.
Bulwark-top splicing and end-fitting.
Skylights over galley.
1. Engine-room stairs and gratings.
2. Boiler-room stairs and gratiings.
Attaching (1) and (2) to plating grab-rods on casing.
All stairs and ladders, including rail-attachments.
Door-frames to casting, hinges, catches, hold coach-hooks, etc.
Clips for attaching interior wood finish to casing.
Entire screen bulkhead.
Coal-chutes.
Butts of W. T. and O. T. boundary-bars on bulkheads or floors in double-bottoms.
Ventilator-cowls.
Stacks and uptakes.
Bulkheads (that are not structural parts of the ship), partition-bulkheads in accommodations.
Framing and supports for engine and boiler-room flooring or gratings.
Cargo-batten cleats.
Tanks (that are not structural parts).
Shaft-alley escapes.
Steel skylights over accommodation-spaces.
Engine-room skylights.
Grab-rods or exterior and interior of deck-houses.
Deck-houses not covering unprotected openings through weather-decks.
Reinforcing and protecting angles round man-holes.
Joints of W. T. angle-collars at frames in way of W. T. flats.
Other parts of a vessel in which electric welding is proposed must be submitted for consideration.

For making and repairing boilers and other pressure-vessels, and in fact as a substitute for riveting generally, arc welding has many applications. In the substitution of the welded joint for the riveted joint, it is recommended that in plate of $\frac{3}{16}$ inch in thickness and over, wherever



Showing How the Electric Arc Simplifies Awkward Corner Riveting. The Edges of the Angle-Irons were Formerly Machined at Their Meeting-Edges and Riveted to Corresponding Strips on the Inside of the Sheet. They Are Now Simply Welded to the Sheet and to Each Other at the Corner.

possible a joint be made as a lap-joint rather than a butt-joint. The amount of lapping should be at least four times the thickness of the plate. The work can be held together preparatory to welding by the use of bolts and after the job is welded the bolt-holes can be filled and chipped smooth. Hammering the metal welded-on after the weld is completed in order to 'pack the metal in' should be discouraged. This is of no benefit and a positive harm may come to the metal from this practice. The chipping-tool can be used, however, to dress the welded joint to make it neat in appearance. In case the welded joint is to be subjected to a pressure-test and it is found that there are small pin-hole leaks, these leaks can be satisfactorily repaired either by chipping out a small amount of metal at that joint and filling with new metal or by a small amount of peening with a centre-punch at the point at which the leak occurs.

On pressure-tanks, where a homogeneous weld free from blow-holes is a necessity, the operator should hold

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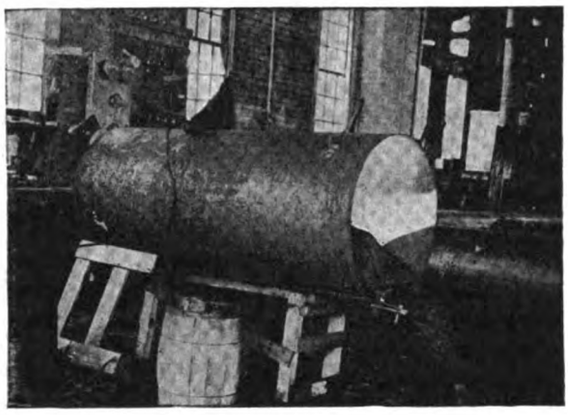
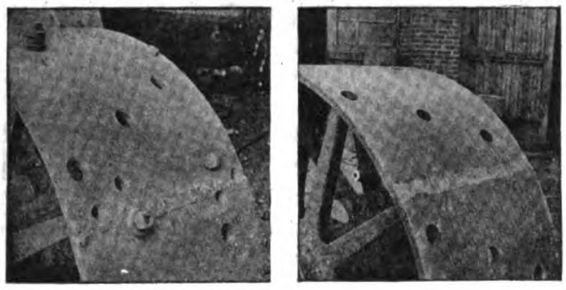
as close an arc as possible and the speed of the work should be sacrificed in order to use a comparatively low current and consequently get the metal into the weld in the best possible condition.

Most of the welding in boiler-shops should be done



Cylindrical Tank in Process of Welding. This Shows a Method of Mounting the Tank on a 'Horse' and Clamping the Edges of the Sheets by Means of Two Plates Secured Together by Bolts.

with the metal electrode, although on plate more than $\frac{3}{4}$ in. thick the carbon arc may be used to increase the speed



Steel Wheel Made by Welding a Steel Plate-Rim and Bolting It to Steel Spokes, Before and After Grinding

of the operation. With the metal electrode 150 amperes current for each operator represents the capacity required in the welding machine. In general boiler-ship practice, the majority of the work would be done with a $\frac{3}{16}$-in. metal electrode and with 150 to 175 amperes current.

Employment Managers Association Meets

The Service and Employment Managers Association of California met on November 29 at the Fairmont Hotel. The principal speakers were members of the staff of the newly-organized Pacific Coast Bureau of Employment Research.

J. D. Houser, president of the Bureau, told how the idea of making available service on personnel problems to all employers has led to the organization of the Bureau, and sketched some of the ways in which the Bureau's varied services could be made of value to the employer.

Roy W. Kelly, author of 'Hiring the Worker' and other books on employment management, called attention to the fact that a shortage of labor was probable for years to come, and that the bad effects of this shortage must be met by increasing the efficiency of the workers. He spoke of the importance of the employment department's obtaining the confidence and co-operation of the foremen, and said that some firms had recognized this to the extent of establishing classes in personnel work for their foremen. He mentioned the present 'epidemic' of schemes for participation in management by employees, and advocated a careful study of conditions in the individual plant before any such plant was adopted. Plans for shop representation should not be used by the employer for the sole purpose of combating other organizations.

S. M. Keyser deprecated the tendency toward closer relations between American labor organizations and those in Europe, where traditions are different, and most men expect to stay in approximately the same position throughout their lives. Here in America, it is still recognized that everyone has a chance for advancement, as is shown by the fact that most of our leaders in industry worked their way from the bottom. The problem of the employment manager he stated to be first to get the man, and then to hold him by giving him a chance to grow and to advance.

W. E. Talbert, director of the Bureau, took as his text, the Bureau's motto, 'What Are the Facts?' and emphasized the importance of the following points: First, the adoption of the scientific spirit, unwilling to accept something simply because somebody said so once. Second, that employers should be willing to spend as much for information about human problems as they are on cost accounting, for instance. Third, the need of finding all the facts. Fourth, the importance of a good system of records and reports for getting the facts.

William L. Henderson, formerly connected with the employment department at Hog Island, discussed some of the difficulties encountered there during the construction period and immediately afterward, both in the employment department and on the entire work.

Ira B. Cross, of the department of economics at the University of California and also connected in an advisory capacity with both the Bureau and the Association, called attention to the fact that the so-called industrial unrest of the present day is nothing new, but that similar unrest has accompanied every period of increasing prices, and may be expected to occur again whenever the cost of living increases faster than wages. Speaking of the lack of knowledge concerning personnel problems of the average employer, he stated that only one concern in California has records sufficiently complete to enable it to determine accurately its cost of labor turnover. That firm finds that the cost of hiring and breaking in a new employee is $800.

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Spiegeleisen in Steel Manufacture

In a report recently issued by the U. S. Bureau of Mines, Henry D. Hibbard calls attention to the fact that spiegeleisen was the first manganese alloy employed for deoxidizing steel made by either the bessemer process or the open-hearth process. The name spiegeleisen was given originally to a white manganiferous pig-iron made in Prussia and containing from 7 to 8% manganese. As time went on richer and richer manganese alloys were made, and these were called ferro-manganese. Our present standard of 80% alloy for ferro-manganese came into general use about 1880. At the present time, the dividing line between spiegeleisen and ferro-manganese may be fairly taken at 40%, all richer alloys being called ferro-manganese and all of 40% or less being called spiegel.

The advantage of a condensed form of manganese, which made ferro-manganese the more popular form for adding the element to the molten metal in the oxidation processes, lies in the smaller weight to be handled, which renders pre-heating and pre-melting unnecessary. It is brittle, enabling it to be easily broken to size when desired. For soft or low-carbon steel there is the important additional advantage of its high ratio of manganese to carbon, about 12 to 1, which favors greatly the making of such steels, in that the carbon content can be kept down while an ample amount of manganese is added. In the harder steels in which more carbon is needed than the ferro-manganese contains, this is provided by adding pig-iron, molten crude iron, or else carbon in the form of coke or coal.

There has never been a doubt as to the suitability of spiegel for making the higher-carbon steels of good quality. Its use requires no particular care, provided that it be melted or heated so as not to cool the metal beyond a permissible amount. When it was supplanted it was for the reasons already given. It has also been used for the softer low-carbon steels.

For instance, one company has used exclusively in its basic open-hearth and bessemer practice, spiegel produced from domestic ores. It has the average analysis given below:

	%		%
Manganese	31.25	Carbon	4.80
Iron	62.25	Silicon	1.43

In the open-hearth, soft, medium, and high carbon steel is produced. The spiegel is added cold. For high-carbon steel three-quarters is added to the bath about twenty minutes before tapping and the remainder to the ladle. For low-carbon steels about half is added to the bath ten minutes before tapping and the other half to the ladle. The manganese in the finished steel is from 50 to 70% by weight of that added. The product is fairly free from red shortness, but the effect on the low-carbon steel is somewhat different from that usually obtained by the use of ferro-manganese. It rises in the molds before 'rimming in'; the ingots are 'thin-skinned', the skin-holes being too near the surface so that some of them are opened in the heating and rolling, causing tears, seams, streaks, pits, and scabs in the bloom or plate into which they were rolled. Whether this is because of the use of spiegel, or because of high silicon, or some other reason, is uncertain.

In the bessemer practice of this company the spiegel is broken to pieces the size of a hen's egg and smaller, heated to redness, and added in the ladle as the charge is poured from the converter. Soft steel only is made, containing about 0.08% carbon. The heats observed all rose in the mold before 'rimming-in', in like manner to the open-hearth steel, although to a lesser degree. The steel, when bloomed, showed defects like those of the open-hearth steel mentioned above.

The United States has large domestic resources of ores suitable for the manufacture of spiegeleisen and of ferro-manganese of a grade lower than the standard 80% alloy. It is estimated that spiegeleisen could be substituted for 80% ferro-manganese in the manufacture of at least 70% of the steel now being produced. There is still some doubt concerning its suitability for the manufacture of the following:

Ingots for plates and the better quality sheets, and for pipe; other low-carbon steel requiring extra fine surface; steel below 0.10% carbon; steel castings made by the converter process where plants are not equipped with crucible or cupola furnaces for melting recarburizers.

In a certain church the pastor took for the text of his sermon, 'Better Church Attendance'.

The pastor held that the automobile had taken more people away from church than any other thing. He concluded with the exclamation: "The Ford car has taken more people to hell than any other thing I can mention." Whereupon an old lady in the congregation began to clap her hands and moan "Praise the Lord! Praise the Lord."

"What's the matter, sister?" asked the pastor.

"The Ford never went any place that it couldn't make the round trip, and I am sure that all of those people in hell will be back," she answered. "So praise the Lord."

Man—"I want your opinion. Would you advise me to borrow $10 to help me out of a tight place?"

Lawyer—"By all means."

Man—"Very good. Lend me ten."

Lawyer—That's all right. My fee for legal advice is $10 and we'll call it square."

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Book Reviews

Commercial Oils, Animal and Vegetable. By I. F. Laucks. Pp. 134. Index. John Wiley & Sons, Inc., New York. Price, $1.25.

As the preface states, this book is intended for the non-technical man in the oil trade. The first chapter discusses the general properties of animal and vegetal oils together with the various tests used in the examination of oils, pointing out particularly how these tests may be employed to detect adulteration. The second chapter describes the principal oils and fats, both animal and vegetal, while the third discusses their uses. The final chapter considers methods of sampling. Special attention is paid throughout the book to the Oriental oils, which have become such an important factor in Pacific Coast trade. The book will be welcomed by the relatively small number of persons interested in the non-mineral oil industry.

Millwrighting. By James F. Hobart. Pp. 438, ill., index. The McGraw-Hill Book Co., Inc., New York. Price, $4.

Under the term millwrighting, the author includes the construction of industrial buildings, and the book will be valuable to those engaged in both design and construction. The first few chapters are devoted to the laying out of buildings and the use of the various instruments employed for this purpose. Then come several chapters devoted to the erection of buildings and the design of structures, including the strength of materials. The remainder of the book may be said to deal with the special problems of the construction of industrial buildings. The several chapters discuss shafting, pulleys, belts and belting, setting-up machines, babbitting, steam and water-pipe fitting, erecting steam-engines, setting steam-boilers, water-wheel setting, and installing electric motors. The book is well-illustrated and the treatment is clear and suited to the needs of the 'practical' man as well as the technically trained engineer.

Mechanical Drawing. By John S. Reid. Pp. 226, ill., index. John Wiley & Sons, Inc., New York. Price, $2.

The author of this book is assistant professor of mechanical drawing at the Armour Institute of Technology, and the book appears to be based on the course given at that institution. It is a good textbook on the subject. An idea of the scope can be gathered from the chapter-headings, which are: Instruments and Their Uses; Drafting-Room Conventions; Freehand Lettering and Geometric Drawing; Orthographic Projection; Representation of Points, Lines, and Planes, Orthographic Projection Applied; Isometric Projection; and Working Drawings. In an appendix, additional matter is included on lettering and geometrical drawing, and shades and shadows and conic sections are also discussed. Another appendix contains what is perhaps the most distinctive feature of the entire book, namely, a summary of the answers to a questionnaire addressed to 200 leading drafting-offices and including 35 questions covering standards of practice from the kinds of dimension lines used to the method of noting changes on a drawing.

Petroleum Refining. By Andrew Campbell. Pp. 282, ill. (together with about 25 large inserts), index. Charles Griffin & Co., Ltd., London. Price, $8.50.

Although petroleum refining is one of the more important of the world's industries, this is the first treatise to be published devoted exclusively to its technology. The book covers the same general lines as the second volume of Bacon and Hamor's 'American Petroleum Industry', although the treatment is not so full as in the latter book, and the present volume is based upon English and Colonial rather than American practice. The latter difference, however, is more in details such as the standard size of tanks rather than in actual processes. The first chapter, which comprises nearly one-third of the book, is devoted to methods of examination and testing of crude oil. Then follows a review of the principal departments and processes in the refinery, including methods of distribution. A chapter is devoted to specifications for tanks, stills, and other refinery apparatus. The appendix contains a bibliography of references relating to petroleum, particularly refining.

Elements of Refrigeration. By Arthur M. Greene, Jr. Pp. 451, ill., index. John Wiley & Sons, Inc., New York. For sale by 'Mining and Scientific Press'. Price, $4.50.

This is a thorough discussion of refrigeration including both the theoretical basis and the practical application. However, the work is arranged in such a way that the 'practical' man, whose training has not been sufficient to enable him to follow the mathematical deduction of formulas, will nevertheless find the book useful. After a brief introduction dealing with fundamental principles, the book considers the various methods of refrigeration. Then follows a discussion of the thermodynamics of refrigerating apparatus and a description of the various types of apparatus. Further discussion of heat transfer and insulation leads to the consideration of cold storage. Chapters following this deal with ice-making and with miscellaneous applications of refrigeration. The next chapter is devoted to costs and the final chapter to the solution of a number of problems dealing with practical applications of the theory of refrigeration. The book will be found useful by anyone engaged in the design, construction, or operation of refrigerating plants.

Engineering Education. Essays for English, selected and edited by Ray Palmer Baker. Pp. 185. John Wiley & Sons, New York. For sale by 'Mining and Scientific Press'. Price, $1.25.

This attractive little book contains 14 articles, all written during the last twenty years, by authoritative exponents of literary English as applied to the expression of scientific ideas. This series of articles is meant "to present an ideal of engineering education" such as cannot be found elsewhere. Each of the seven divisions of the general subject is discussed by two distinguished men: 'The Origins of Engineering Education', by Simon Newcomb and J. J. Thomson; 'The Types of Engineering Education', by John Butler Johnson and Howard McClenahan; 'The Bases of Engineering Education', by John Lyle Harrington and Charles P. Steinmetz; 'Mathematics', by Sir William White and Arthur Ranum; 'Physics', by Matthew A. Hunter and Robert A. Millikan; 'Chemistry', by John B. C. Kershaw and Alfred Senier; 'Imagination', by Isham Randolph and Julian C. Smallwood. It will be noted that several Englishmen take part in the symposium. The book is not only a discussion of a timely and engrossing subject, but it furnishes an excellent example of style to those desirous of improving their use of the language. It is a book for thoughtful men and women.

INDUSTRIAL EQUIPMENT

A NEW PORTABLE AIR-COMPRESSOR

Portable compressors of many varieties have been developed in the few years just past, each successive design bettering the one which preceded it. Now there appears a new type. The Ingersoll-Rand Co. has introduced a light-weight gasoline-engine driven unit, built in two sizes, to be known as the Imperial Type 14 portable compressor. These are all-steel outfits, from their sheet-steel canopy to

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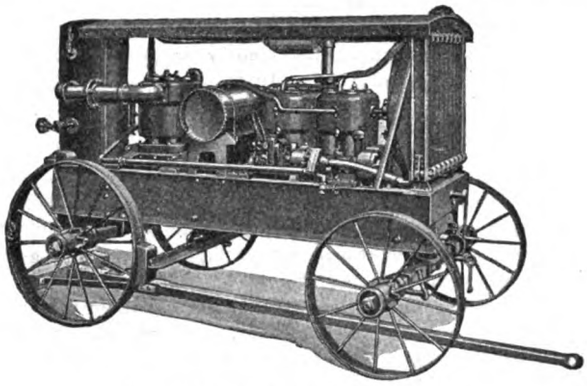
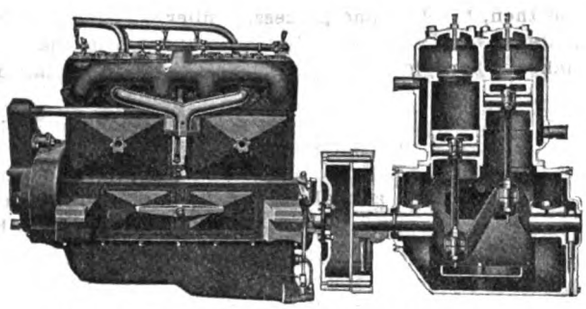
the broad tired steel wheels. The power plant of each consists of a duplex, vertical-compressor, driven at high speed, by a four-cylinder, four-cycle, tractor-type gasoline-motor. It is pointed out that the outfit, being designed especially for portability, has had unnecessary weight eliminated, and affords maximum air-power output per unit weight. The larger machine, of 210 cu. ft. capacity, weighs only 6000



118-cu. ft. Imperial Portable Compressor

lb., and the 118 cu. ft. unit 4000 lb. A point is also made of the fact that the gasoline-motor drive provides power in an economical form and by a mechanism that can be confidently entrusted to the average operator, for men familiar with gasoline engines are everywhere available and make thoroughly competent engineers.

The compressors have cylinders cast 'en-bloc', with cylinder heads, valve chambers, and water jackets integral. Both intake and discharge valves are of the plate type and are situated directly over the cylinder-bore. Crank shafts and

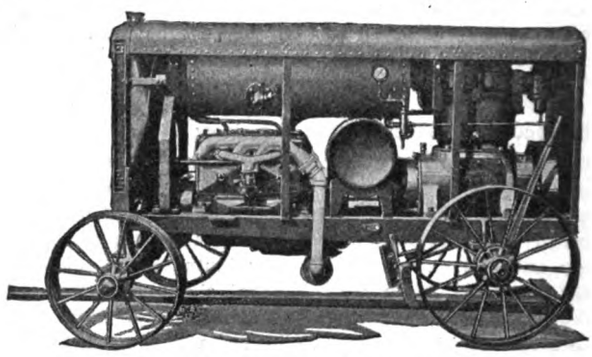


Sectional Power-Plant 118-cu. ft. Portable Compressor

connecting rods are drop forgings. Air pistons are fitted with three-piece piston rings and, in addition, with an oil-wiper ring. This latter returns all surplus oil from the cylinder walls to the crank case, and is claimed to obviate the difficulty caused by having the air carry an excess of oil into the receiver. All bearings are die castings of anti-friction metal. Hand holes in the crank-case permit convenient access for adjusting main bearings and those of the crank-pins. Al parts are lubricated by splash from an oil reservoir in the crank case. The compressors are provided with inlet unloading devices which automatically close the compressor intake when the receiver pressure rises above a predetermined limit, and permit the machine to again take up its load when the pressure has fallen a definite amount.

The gasoline driving-motors are of long-stroke type, and operate at medium speed. They are equipped with high-tension, magnetic ignition with automatic governors to maintain constant speed under all working conditions and to prevent overspeeding when idling. A splash oiling system lubricates all moving parts. Starting crank is located at the front of the machine beneath the radiator. Both compressor and driving-motor are water cooled by a circulating system, with centrifugal pump, large radiator, and powerful blast fan. The manufacturer directs attention to the fact that the radiators are made up of removable sections, a construction that allows the removal and repair of a damaged section without taking down the entire radiator or interrupting the use of the compressor.

Each of these units is equipped complete with receiver, safety valve, drain valves, pressure gauge, and service valves to which the air hose lines may be attached. When the fuel tank has been filled, lubricating oil provided, and the cooling system supplied with water, the units are ready for work. The mounting is worthy of note, particularly the swiveled front axle, which moves freely in both horizontal and vertical planes. This, with the rigidly attached rear axle, gives three point suspension, and permits the



210-cu. ft. Imperial Portable Compressor

outfit to pass over inequalities of the ground without any racking effect or misalignment of the power plant.

The two sizes differ in respect to the situation of the air receiver, and in minor details of design. These differences, in general, can be seen from an inspection of the accompanying illustrations.

HOW PHYSICAL PROPERTIES OF A MATERIAL AFFECT GRINDING ACTION*

By W. T. Montague

There are two things an abrasive must do in order to remove a chip; first, penetrate the metal being ground; and second, stand up to the cut while being forced through the metal.

Therefore, the two physical properties of a material that affect abrasive action most are:

1. Resistance to penetration.
2. Tensile strength of the material.

High resistance to penetration and high tensile strength do not necessarily go together. To illustrate this point, consider glass, which is of high resistance to penetration, but of low tensile strength; phosphor or manganese bronze, which is of low resistance to penetration, but comparatively high tensile strength; white iron, which is of high resistance to penetration and low tensile strength. Other similar examples might be quoted.

There are two general conclusions to be drawn from these instances just cited, namely: The greater the resistance to penetration, the more brittle should be the abrasive, and the finer should be its size.

Of course, this article presupposes that the abrasives under discussion are much harder than the materials they are required to cut. (We refer to mineralogical hardness.) An abrasive of a brittle temper usually fractures with sharper points and cutting-edges than a tougher abrasive. Hence, it has a better opportunity to penetrate a hard dense surface

*From 'Grits and Grinds'.

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than a tougher abrasive would have. This perhaps partly explains why the more brittle-tempered aluminous abrasive known as No. 38 alundum is so much better adapted for hardened tool-steel than the tougher regular alundum and why the aluminous abrasive of intermediate temper known as No. 66 alundum is better suited to the grinding of manganase steel than either of the abrasives mentioned above.

The second factor affecting penetration is the size of the grit employed in the wheel and, generally speaking, the greater the resistance to penetration, the finer the grit should be. To illustrate this, a case may be cited where great difficulty was being experienced in grinding hard high-speed steel. Following the usual reasoning, it was attempted with as soft and coarse a wheel as could be readily made for that particular operation, namely, a 3824-G silicate. This wheel acted hard and glazed, heating the work badly. By changing to a 3846-G silicate, a much freer-cutting wheel was obtained and all trouble eliminated.

Reasoning from this and other examples of like nature, we conclude that the finer cutting-grain penetrates the metal being ground more readily than the coarser grit, and, although the individual chips produced may be smaller, there are more of them. In other words, on hard materials the fine wheel 'bites' better than the coarse. The coarse grits seem to ride over the surface of the metal, in doing which they get dull and gradually produce a glazed face on the grinding-wheel. The broader the contact, the more pronounced are these tendencies.

But the second factor mentioned earlier in our article—the tensile strength of the material—probably exerts a considerably greater effect on grinding action than resistance to penetration. An abrasive grain must be tough enough to withstand the shearing stress encountered when the grains are forced to remove chips of metal.

The metal opposes the removal of chips with a force that is proportional to its tensile strength. The higher the tensile strength of the metal, the harder it is to remove a chip and the tougher the abrasive must be to prevent fracture while the grain is making the cut. It should be brittle enough, however, to allow fracture when the edges have become dull or should be bonded soft enough so that dulled particles will be torn from the face of the wheel before they glaze and cause what is termed hard grinding action.

This explanation perhaps makes it clear why alundum is the type of abrasive to use for grinding steel. Obviously, because of its high tensile strength and toughness, steel must be ground with a tough abrasive. The carbide-of-silicon abrasive, crystolon, because of its brittleness, fractures too readily in cutting to be efficient in the removal of material from high-tensile strength metals. It will grind steel and high-tensile strength materials, but not as efficiently as alundum because it does not hold up long enough under the cut to do the maximum amount of work.

For materials of low-tensile strength, crystolon is the correct type of abrasive. This is true because the resistance of low-tensile strength materials to the removal of chips is far less than in the case of steel, and the brittle crystolon grain is able to cut through without breaking off before it has done its work. Low-tensile strength materials offer enough resistance to crystolon to fracture it sufficiently to keep the wheel sharp. Because alundum is tougher than crystolon, the low tensile strength materials do not offer sufficient resistance to fracture it, but merely tend to dull it. Hence, the grains become worn smooth and the wheel glazes. Alundun is not adapted to materials such as cast-iron, brass, or aluminum.

One way to adapt an alundun wheel to cast-iron and materials of low tensile strength is to employ less bond or, in other words, use a wheel one or two grades softer than in crystolon. However, this is not an economical method of grinding, inasmuch as the abrasive is torn from the wheel-face before it has done all the work of which it is capable. That is, the wheel is kept sharp by the cutting-grains being pulled from their setting rather than by their fracturing.

Alundum wheels are also used for certain precision operations on so-called cast-iron, especially piston-rings. This may be explained by the fact that such castings usually contain a high proportion of steel, which so changes the physical properties of the metal that alundum many times cuts as well as crystolon and finishes better. Also, the harder bronzes may be ground efficiently with alundum wheels, especially the machine-grinding operations. The tensile strength of this material is often quite as high as mild steel, which explains the tendency toward the use of an aluminous abrasive like alundum.

WELDING STELLITE TO CARBON-STEEL SHANKS

When using either the electric-arc or the oxy-acetylene process, the shank should be prepared so that the cut-out for the bit is chamfered at about a 45° angle from the centre of the shank. The tip may be of ordinary rectangular stock or may have the top-rake cast on. A gas-furnace is satisfactory for pre-heating the tools, and the weld should be made in the following manner:

Weld a small spot of the bit and the shank together, then pre-heat to about 1600°F., and finish the weld by filling with a good grade of nickel-steel or drill-rod. This can be accomplished in the usual manner of making welds, with either the electric or oxy-acetylene process. After the weld is finished the tool should be placed in air-slacked lime, bone-dust, or some similar substance, so that it may cool evenly.

Either method mentioned will be found satisfactory in most cases, but in extremely heavy cuts it is better to use stellite of the same grade as the tip for a filler. In using stellite as a filler a carbon-pencil should be employed to draw the stellite from the tip along the apex of the cut-out, and then, by the same process, a filler of stellite should be melted into the opening between the tip and the shank. This makes a hard joint, and the loss from tips coming off the shanks is less than 1%.

When 'Tip-It' welding compound is used the shank may be prepared with a square recess for the tip or it may be milled out so as to leave a fin on the side opposite the cutting edge, so that a small square may be used as a tip. To get the best results in making stellite-tipped tools with 'Tip-It' compound, an undercurrent gas, coke, or oil furnace should be used. The stellite should be placed about the centre of the shank, and both placed in the fire, bringing them to about 1600°F., at which heat they should be removed, the scale taken from the shank with a file or scraper, and a thin layer of compound placed along the cut-out, the tip put in place, and a slight pressure brought to bear on the tip so as to give it a good seat. The tool should then be returned to the fire and the heat increased gradually, until the spelter or compound begins to work in the joint between the bit and the shank. The welder should then watch the tool until a fine bluish flame appears. This flame usually appears at a heat of from 1900 to 2000°F., and goes upward along the tip. At any time after it appears, the tool may be removed from the fire and about 100 lb. pressure may be brought to bear upon the tip. At this time the weld will be finished. The pressure may be applied with a pair of blacksmith-tongs, an inverted vise, an arbor-press, or any device of like nature.

THE MORSE RAREFIED DUST-COLLECTOR

For users of grinding-wheels, sand-blast outfits, tumbling-mills, and other equipment that produces large quantities of dust and grit, the Knickerbocker Co., of Jackson, Michigan, is manufacturing under the basic patents of O. M. Morse, the New Cyclone Dust-Collector, shown in the ac-

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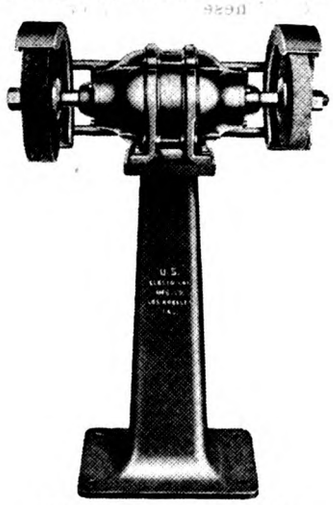
companying illustration. The dust-laden air entering the device is given a whirling motion, which separates from it all but the impalpably fine float-dust. There are no moving parts, and as the air passes through the collector before reaching the fan, there is no cutting of the fan. The ma-

The Morse Dust Collector

terial collected is discharged automatically. Except for the few cases where conditions require complete purification of the air from fine dust, the device is superior to a cloth-screen type, and even where special requirements compel the use of a cloth-screen collector, it is advisable to use a Morse collector with it, to take out the coarse material, and reduce the strain on the cloth-screen machine.

THE JOHNSON ELECTRIC BUFFER

In place of the old-style buffing-head with its loss of power from slipping belts, the U. S. Electrical Manufacturing Co., of Los Angeles, has developed the self-contained



Self-Contained Buffing Outfit

buffer shown in the accompanying illustration. All working parts are enclosed, ensuring safe operation. The elimination of shafting and belts means a considerable saving in space occupied. The buffer is ball-bearing and uses very little current. It is made in various styles, to operate on alternating current, 110 to 550 volts, 1, 2, or 3 phase, 25 to 60 cycles, or on direct current, 110 and 220 volts.

THE KLAXOCATOR

Telephoning department after department in order to find a man is irritating and wasteful. Valuable time is lost and, in each department called, somebody has to drop his work to say "Not here". Furthermore, the handling of regular telephone messages is seriously hampered. To obviate these difficulties, the Klaxon Co. has developed the Klaxocator. This is a code-sending instrument for operating signals in

The Klaxocator

every department at once. It is usually placed within reach of the switchboard operator. Each department head and each important man in the organization is assigned a code-number. When anyone on the code list is wanted, the operator turns the knob to his code number, and pulls a lever. This flashes a signal to every department. When his number is called in this way, the man wanted goes to the nearest telephone, and is connected instantly with the man wanting him. The instrument has a range of 40 code-numbers. Two distinct signal-systems can be operated; a code-signal system for finding men, for time signaling, and for similar uses; and a fire-alarm system. A white lamp shows when the code system is in use and a red lamp when fire-alarms are sounded. The Klaxocator can be operated on low-voltage and also on light and power circuits.

Trade Notes

The Acme Lithographing Co. will construct a $100,000 plant at Fresno.

The American Can Co. will construct a $1,000,000 factory-building at Portland.

The Kingsburg Bank, of Kingsburg, California, will construct a $100,000 building.

The Edison Electric Appliance Co. will double the capacity of its plant at Ontario, California.

The California Theatre & Realty Co. will construct a $250,000 theatre-building at Fresno.

The B. & C. Machinery Co., of Haywards, is planning to build a new boiler-shop early in the year.

The American Motor Repair Co. has opened an automobile-repair shop at Post and Gough streets.

The Standard Oil Co. will construct a 12-story class A office building at Bush and Sansome streets.

Henderson Bros. are to build a machine-shop for repairing automobiles at Tranquillity, California.

F. L. Chitwood, H. Roberts, and **John Running** have purchased the joinery plant of the Rogers shipyard at Astoria.

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and will use the machinery at the nucleus for a sash-and-door factory.

The Campco Tractor Co. will construct a tractor-building plant at Stockton.

A. E. Triplett and **Walter Baxter** have opened a tractor and automobile repair shop at Paso Robles.

The city of Los Banos has purchased the local water-system and will spend $36,000 on extensions.

The Schmidt Lithograph Co. will construct an addition to its plant on Second street at a cost of $29,210.

The American Foundry Co., of Seattle, has planned a heavy timbered addition 30 by 150 ft. to its plant.

The plant of the **Palmolive Co.**, of Portland, was destroyed by fire. The loss is estimated at $350,000.

The plant of the **Portland Stove Works**, of Portland, was destroyed by fire. The loss is estimated at $250,000.

A bond issue of $1,800,000 for construction of a system of county highways has been voted in Butte county.

The San Francisco Radiator & Fender Works will open a new plant to build automobile bodies at 1650 Pine street.

The National Paper Products Co., of Stockton, will double the capacity of its boxboard mill. The estimated cost is $1,000,000.

Montgomery, Ward & Co. will construct an eight-story concrete building at Portland. The estimated cost is $1,350,000.

The Miller Manufacturing & Machine Co. has opened for business at Centralia, Washington. W. J. Miller is in charge of the plant.

Busch-Sulzer Bros. Diesel Engine Co., of St. Louis, has established headquarters in the Rialto building, in charge of A. A. Tacchella.

The Central California Bank & Trust Co. will construct a 14-story class A office-building at Fresno. The estimated cost is $300,000.

The Bully Hill Mines, Inc., will erect a zinc-reduction plant at Winthrop, California, early in 1920 at a cost in excess of $600,000.

The Windlinx Hardware Co., Fort Bragg, will open a machine and gas-engine repair-shop at Noyo as soon as a suitable site is obtained.

The Whalen Pulp & Paper Co. will construct a paper-mill with a capacity of 10,000 tons of pulp annually at Port Angeles, Washington.

The Centennial Mill Co., of Spokane, has acquired four blocks of land in that city and plans a plant that will eventually cost $1,000,000.

A contract has been let by the **Best Steel Casting Co.**, Oakland, for a pattern-shop at a cost of $25,000, and a foundry to cost $10,000.

The Hart-Parr Co., manufacturing tractors at Charles City, Iowa, is considering the establishment of an assembling plant at Sacramento.

A bond issue of $125,000 for construction of an irrigation system has been voted by the Scott Valley Irrigation District in Siskiyou county.

Fire from an unknown cause destroyed the sawmill of the **Standard Lumber Co.**, at Standard City, California. The loss was about $150,000.

C. F. Braun & Co. have moved their offices from the Cunard building to the top floor of the Atlas building, corner Mission and Second streets.

The San Joaquin Light & Power Corporation will double the capacity of its steam-electric plant at Bakersfield. The estimated cost is $1,000,000.

The C. C. Pratt Lumber Co., of Okanogan, Washington, has purchased a site adjoining the city limits of Spokane, where it will establish a mill under the name of the **Appleway Lumber Co.** The firm has been incorporated with a capital of $30,000.

F. C. Wiltsie is building a one story concrete building, 50 by 110 ft., in Seattle to be leased to the **Ajax Tire & Rubber Co.**, as a factory branch.

The Novelty Foundry Co. has been started in Honolulu by Peter Nielsen and Mathew Holzinger, specializing on brass, bronze, and aluminum castings.

After a delay of several weeks because of the strike, the **Moore Shipbuilding Co.** launched six steel vessels at its yard on the Oakland estuary on December 20.

Herberts Machinery & Supply Co. has taken over the exclusive selling rights for California for the Wilmarth & Morman Co., of Grand Rapids, Michigan.

The Seattle Boiler Works has been awarded a contract for the erection of four 50,000-gal. steel oil-tanks at the Smith Cove terminal for the Port of Seattle.

The Crown-Williamette Paper Co. will commence construction immediately on an additional mill to be completed during the present winter, at West Linn, Oregon.

Barbare Bros., of Tacoma, will increase their shipbuilding equipment by the construction of a new wood-shipbuilding yard having an area of 2½ acres. Their old yard will be used as a repair plant.

The Greene Co., of Corning, will discontinue job and machine-repair work at its foundry and will confine itself to the manufacture of its new rotary gas-engines, pumps, and similar equipment.

R. W. A. Brewer has left San Francisco and will make his headquarters at Indianapolis, where he will act as consulting engineer for the Marmon Motor Car Co. and several other automobile companies.

On December 15, the **Skinner & Eddy Corporation** delivered the steel steamer 'Cross Keys' to the U. S. Shipping Board. This completes the corporation's contract for 65 vessels for the Shipping Board.

Robert L. Mackay, Pacific Coast manager for the **Columbian Hardware Co.**, of Cleveland, will open an export department at 61 Montgomery street, to handle trade with Australia, New Zealand, and the Far East.

Early in the year **Fairbanks, Morse & Co.** will start the construction of a $1,500,000 foundry at their plant at Beloit, Wisconsin. The new foundry will cover 11 acres and will have modern equipment in every respect.

Improvements at the **Eclipse Sawmill**, Everett, Washington, are under way. These include a two-story frame building 80 by 340 ft., which is to be equipped with the latest lumber-finishing machinery, electrically driven.

G. E. Robinson, G. O. McCroskey, and E. P. Currey, of Portland, have incorporated the **Currey Ball-Bearing Springs Co.**, with a capitalization of $25,000. The company will manufacture engines and ball-bearing springs.

The Federal Ornamental Iron & Bronze Co. has been organized in San Francisco with a capital of $50,000 by Franz Wolff, Alexander Raymond, C. P. Hauselt, G. R. Marshall, A. J. Kopp, William Davis, and A. A. Tiscornia.

The Healy-Tibbitts Construction Co. has been awarded contracts for piling and the **Western Pipe & Steel Co.** contracts for six tanks to be erected for **Willits & Patterson** on Islais creek. The tanks will be used for storing oil.

The Moore Shipbuilding Co. has purchased from **Harron, Rickard & McCone**, one 20 by 168-in. plain self-contained Landis grinding machine. This will be used for grinding shafting 12 ft. 6 in. long by 8 in. diam. for marine engines.

The General Petroleum Co. has awarded a contract to the **Western Pipe & Steel Co.** for fabricating approximately two thousand tons of steel plates for tanks for use in Mexico. The contract price is said to have been approximately $225,000.

The California Fruit Exchange has purchased the mill and other property, including timber holdings, of the Davies Box & Lumber Co. near Blairsden, Plumas county. The mill will be enlarged and considerable new machinery purchased.

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James Lynch, formerly manager for the Herring, Hall, Marvin Safe Co., has been appointed vice-president and business manager for the **American Coin Register Co.,** of Emeryville. **C. C. Vogelsong,** president of the American Coin Register Co., will act as factory manager.

R. C. Monteagle, president and general of the Pacific Construction & Engineering Co., has returned to Seattle from a six months' trip in the Orient, which he made to investigate trade conditions on behalf of his own company and of the Manufacturers' Association of Seattle.

W. B. Kyle, 74 New Montgomery street, has bought the reinforcing steel and lumber in place for the construction of hull No. 1649 at the Government concrete-ship yard in the Oakland estuary. Everything was ready for pouring the concrete when orders came to stop work.

M. Barde & Sons, Inc., of Portland, has purchased from the U. S. Shipping Board, its entire surplus stock of steel plates, anchors, bars, chains, and other machinery and equipment, about 250,000 tons in all. This is said to be the largest transaction of its kind ever consummated.

The Ashland Iron Works, of Ashland, Oregon, is reported to have taken a contract to build 100 Downie tractor-cultivators for a Seattle firm. The machine is to be built from plans designed by W. F. Downie, of the United States Iron Works, of Seattle, and the machines are to be shipped to the vicinity of Spokane for use in orchards.

It is announced that arrangements have been completed between a number of lumber firms of Klamath Falls, Oregon, and **Tartar & Webster,** of Stockton, box manufacturers, to build a planing-mill at Dorris, California, with a yearly capacity of 25,000,000 ft. to be ready to handle the next year's lumber output of the firms concerned.

F. W. Sinram, general manager for the Van Dorn & Dutton Co., of Cleveland, has been elected president of the company. Mr. Sinram is also president of the American Gear Manufacturers Association. **Franklin Schneider,** president of the Van Dorn Electric Tool Co., has been elected vice-president of the Van Dorn & Dutton Company.

The Coos Bay Shipbuilding Co. will salvage most of the equipment left on its hands and dispose of the site as soon as practicable. The machine-shop, which is said to be one of the best woodworking machine-shops in that part of Oregon, will be maintained intact for the present in the hope of selling it as it stands. The rest of the machinery and equipment will be sold as soon as individual purchasers can be found.

A contract for the enlargement of **Catton, Neill & Co.'s** plant at Kakaako, Hawaii, has been let to **J. L. Young Engineering Co.** for $125,000. This contract is merely for construction work, all the material being supplied by the company's foundry. The improvements include a large machine-shop of concrete and steel, a boiler-shop of the same construction, and a warehouse with concrete floors and galvanized roof and sides.

The Woodward Way Manufacturing Co., of North Sacramento, has been incorporated for $100,000 and is planning to erect a new $20,000 building on its property across the boulevard from the Liberty Iron Works. Considerable machinery and equipment is to be installed. The company manufactures automobile appliances and parts. The business was formerly conducted as a partnership by H. A. Woodward and F. B. Rutherford.

The Niedringhaus Metalware Corporation, an Illinois concern, capitalized at $1,200,000, has filed articles of incorporation in Alameda county. The company has taken a lease on a tract of land on Webster street near the Oakland estuary. It is announced that it will manufacture steel drums for oil and gasoline immediately and as soon as machinery can be obtained will manufacture automobile bodies for the Chrevolet Automobile Company.

The California Tractor and Implement Association has decided that in place of one large tractor demonstration at some central point, which has been the rule in former years, in 1920 eight local demonstrations will be given: at Fresno, San Jose, Salinas, Stockton, Sacramento, Marysville, Chico, and Santa Rosa. It is believed that the new arrangement will make it easier for those interested to attend than when a single demonstration was held.

The U. S. Electrical Manufacturing Co. has recently been awarded contracts for furnishing about $50,000 worth of equipment to the Goodyear Tire & Rubber Co., of California, including grinders and motors for the company's new plant at Los Angeles, and vertical ball-bearing motors for its cotton fields in Arizona. The U. S. Electrical Manufacturing Co. is also furnishing motors and control-equipment for the plants of the Co-operative Furniture Co., E. F. Butler, and Carraher & Ekman Co., all of Los Angeles.

The shipbuilding activities of the Skinner & Eddy Corporation will be taken over by the **Skinner & Eddy Shipbuilding Co.** The principal officers of the Corporation are also interested in the new company. The Skinner & Eddy Corporation will confine its activities to the operation of four steamships about to be completed and to the various milling and other enterprises in which the firm is interested. The new company will take over the so-called No. 1 shipbuilding plant, including the drydock and ship-repairing plant. The No. 2 plant is not affected by these changes, as its status is now a subject of negotiation between the Corporation and the U. S. Shipping Board.

The Coast Equipment Co., with offices at 407 Merchants Exchange Bdg., San Francisco, has been appointed exclusive sales agent for California and Nevada for the following companies: Ridgway Dynamo & Engine Co., Ridgway, Pa., manufacturing turbo-generator sets, alternating and direct-current generators, motor-generator sets, steam-engines, synchronous motors. Pittsburgh Transformer Co., Pittsburgh, transformers. Atlas Car & Manufacturing Co., Cleveland, electric storage-battery and trolley locomotives, storage-battery flat-cars, and industrial cars. Norwalk Iron Works Co., South Norwalk, Connecticut, air, oxygen, hydrogen, and carbonic-acid gas compressors, and automatic ammonia compressors. Duncan Electric Manufacturing Co., Lafayette, Indiana, watt-hour meters.

Market Review

Although the coal strike is over and the steel strike appears to be dying, production is still below normal in almost every department of the iron and steel industry, and both furnaces and mills are getting further and further behind. The shortage in particular lines, such as nails and sheets, has become acute. As a result of these conditions, prices are advancing all along the line. No. 2 foundry pig-iron is being quoted at Pittsburgh at $39 to $41, and the prevailing price on billets is $48, or $9.50 higher than the prices established last March by the ill-fated price-fixing board. While the U. S. Steel Corporation has thus far refused to advance its quotations on most finished products, these figures mean relatively little in the present shortage, since large premiums are being paid for immediate or even for early delivery. Ferro-manganese has also advanced, the 80% grade now selling up to $150 at Atlantic ports. The local market shows a brisk demand in nearly all lines, the chief problem being how to fill orders rather than how to get them. Finished steel has advanced, and is now quoted at $3.85 mill base, and $4.35 warehouse.

The local scrap market is practically unchanged, cast-iron scrap selling for $42.50 and steel scrap for $25.

WANTED—A McLain graduate for position in Mexico, chiefly mining and railroad work. Address PA 107, Metal Trades.

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